

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 19 May 94	3. REPORT TYPE AND DATES COVERED 15 Mar 93 - 14 Mar 94
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4. TITLE AND SUBTITLE Evaluation of US-Japan Industry & Technology Management Training Program	5. FUNDING NUMBERS C-F49620-92-C-0021
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6. AUTHOR(S) Thomas C. Mahoney	
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Academy of Sciences 2101 Constitution Ave., N.W. Washington DC 20418	8. PERFORMING ORGANIZATION REPORT NUMBER AFOSR-TR-93-0262
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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NI 110 Duncan Ave Ste B115 Bolling AFB DC 20332-0001	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
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11. SUPPLEMENTARY NOTES	
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12a. DISTRIBUTION/AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
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Approved for Public Release; Distribution Unlimited

13. ABSTRACT (Maximum 200 words)

The 10 member committee, formed to assess the US-Japan Industry & Technology Management Training Program, was chartered to (1) review each center's proposed plan of action, (b) assess how effectively the plan of action was being implemented (3) determine the extent to which each center was meeting the goals of the legislation and (4) to identify cost-effective ways to maximize the value of the centers to American industry.

DTIC QUALITY INSPECTED 5

14. SUBJECT TERMS	19950615 024	15. NUMBER OF PAGES 67
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17. SECURITY CLASSIFICATION OF REPORT unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT unclassified
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Learning from Japan

Improving Knowledge of Japanese
Technology Management Practices



Learning from Japan

Improving Knowledge of Japanese Technology Management Practices

COMMITTEE TO ASSESS U.S.-JAPAN INDUSTRY AND
TECHNOLOGY MANAGEMENT TRAINING PROGRAMS

Manufacturing Studies Board
Commission on Engineering and Technical Systems
National Research Council

Washington, D.C. 1994

Accession For	
NTIS CRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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This study was supported by Contract No. F49620-92-C-0021 between the Air Force Office of Scientific Research and the National Academy of Sciences.

Available in limited supply from

Manufacturing Studies Board
National Research Council
2101 Constitution Avenue, N.W.
Room HA 286
Washington, D.C. 20418

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Printed in the United States of America

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Preface

In the National Defense Authorization Act of 1991, the Congress provided \$10 million to the Secretary of Defense to establish a program in "U.S.-Japan Industry and Technology Management Training." The Air Force Office of Scientific Research (AFOSR) was assigned to administer this new program, which provides support to universities, colleges, or nonprofit institutions to study Japanese methods for industry and technology management. According to the enabling legislation, "a major purpose of these programs shall be to prepare scientists, engineers, and managers to learn from their Japanese counterparts by being able to work closely with them throughout their careers in government or industry."¹ To accomplish this, "the programs should provide training in the Japanese language and an understanding of Japanese business and social culture." The programs should also provide their participants with opportunities "to be directly involved in Japanese scientific research, engineering development, and management programs, and should be structured to help keep U.S. government and industry abreast of Japanese scientific and technical developments and their importance" (U.S. House of Representatives, 1990).

In response to this legislation, the AFOSR issued a Request for Proposal on 10 May 1991. Four key goals were established for the program: (1) increase understanding of Japanese industry and technology management methods for the creative use of science and technology; (2) provide U.S. citizen and permanent resident scientists, engineers, managers, and students of industry and technology management training in the Japanese language and an understanding of Japanese business and social culture; (3) provide program participants with opportunities to be directly involved in Japanese scientific research, engineering development, and management activities; and (4) provide mechanisms for participation in the programs of scientists, engineers, and managers from the Department of Defense and Department of Energy laboratories (U.S. DoD, 1992). Twenty-five proposals were received, and four awards for two years each were granted on 30 September 1991. The awardees were the Massachusetts Institute of Technology; the University of Michigan; Vanderbilt University; and the University of Wisconsin on behalf of the Engineering Alliance for Engineering Education (EAGLE), a consortium of 13 engineering schools, and the National Technological University.

An additional \$10 million was authorized in the 1992 Defense Authorization Act, which was used to fund another four programs. These awardees were Stanford University; the University of California, Berkeley; the University of Pittsburgh in conjunction with Carnegie-

Mellon University; and the University of New Mexico in conjunction with the University of Texas at Austin.

In fiscal year 1993, the program again was funded at \$10 million. A fifth goal was added to the original list: create mechanisms for the cooperation and involvement of U.S. industry and government in applying and employing the results of this program. Although there was no guarantee of continued funding for the first four awardees—whose initial two-year awards would have expired—, these schools were invited to submit proposals for another two years of funding. Based on the proposal evaluations, all of the 1991 awardees except Vanderbilt received new awards, and two new programs were funded: the University of Washington and the University City Science Center, a Philadelphia consortium that includes the University of Pennsylvania, Drexel University, Temple University, and several other smaller schools in the area.

In July 1992, the Acting Director of Education, Academic, and Industry Affairs, Air Force Office of Scientific Research requested that the National Research Council establish a committee to assess the newly created U.S.-Japan Industry and Technology Management Training Program. The National Research Council authorized two of its units, the Manufacturing Studies Board of the Commission in Engineering and Technical Systems, in cooperation with the Office of International Affairs' Office of Japan Affairs, to form the committee. The committee was asked to summarize and critique the approaches taken by the first four universities to receive funding from AFOSR; these findings were published in an interim report completed in September 1993 (NRC, 1993). The committee was also asked to provide a critical evaluation of the total program, identifying lessons learned and recommending steps to improve the program in the future. In particular, the committee was asked to (1) describe specific, appropriate criteria by which to determine the benefits of the program and to assess these benefits, (2) determine the value of the program to the target constituency in U.S. industry, (3) identify members of that constituency that deserve greater attention, and (4) make recommendations to strengthen the effectiveness of the program as more universities are funded.

STUDY METHODOLOGY

The research process adopted by the committee in response to the AFOSR request included three major elements: (1) the committee met with the program directors as a group in August 1992 and March 1993; (2) the committee visited, as subcommittees of three to five persons, all eight of the universities or groups of universities receiving funding in fiscal years 1991 and 1992, and solicited written information on each program's curricula, research activities, contacts in Japan, outreach efforts, and other program aspects; and (3) the committee reviewed relevant literature on Japanese management practices.

The research and deliberations of the committee have resulted in a number of conclusions concerning the value of the U.S.-Japan Industry and Management Training Program, steps to maximize the program's value given its limited resources, and realistic expectations of what the program can contribute to U.S. industry and academia. The committee makes a number of observations regarding the difficulties of transplanting

Japanese management practices to a U.S. cultural and economic context and the need, therefore, for the awardees to work closely with their customers in industry. Finally, the committee offers recommendations to strengthen the total program by building on the individual strengths of the awardees and suggesting ways to increase the levels of coordination and cooperation among them.

REPORT STRUCTURE

This final report is divided into five parts. Chapter 1 provides the context in which the committee believes Japanese industry and technology management practices must be studied and taught. Chapter 2 presents the committee's assessment of the research, language and culture, and curriculum development aspects of the program. It includes suggestions for strengthening these aspects in the future. Chapter 3 addresses issues that need to be confronted if Japanese technology and industry management is to emerge as a viable academic specialization for engineering and management students. Chapter 4 discusses the need for greater industry involvement if the program is to meet Congress' objectives. Chapter 5 discusses how the total program could be strengthened through much closer coordination among the individual awardees and, in the longer term, through cooperation with other campuses and organizations by using computer networks and other appropriate technologies. Finally, Chapter 6 summarizes the committee's assessment of the program to date and provides recommendations for improving overall program management, measuring success, and achieving a strong long-term future for Japanese industry and technology management training.

Several appendices are also included. Appendices A and B contain the enabling legislation for the program and the latest Request for Proposal used by the AFOSR. Appendix C is a short monograph by Mark Fruin on "Cultural Relativity and the Study of Japanese Management." Appendix D contains a summary of the programs funded in the second round of awards. This summary provides similar information, albeit in condensed form, to that found in the committee's interim report issued in July 1993. Appendix E describes other Japanese oriented organizations and activities in North America.

This report is made in conformance to the task statement. It is not a proposal review process, though the committee found that the selected programs all conform closely to their proposals.

It is clear that in most cases with one notable exception these programs are weakest in providing mechanisms for participation of scientists, engineers, and managers of U.S. industry and of Department of Defense and Department of Energy laboratories. Nor have these programs been successful in bringing Japanese counterparts to the United States for exchange activities.

These areas of concern are not unique to the U.S.-Japan Industry and Technology Management Program. They are typical of so many well intentioned government-funded programs in that the problems or opportunities are controlled from the supply side (i.e., university/research laboratories) rather than the demand side (i.e., industry and national laboratories). This supply-side thrust is unique to the United States and differs diametrically

from the European approach (e.g., that of the Fraunhofer Institutes) or the long delayed Japanese Intelligent Manufacturing System initiative, in which all research contracts were to be directed by industrial concerns.

It is ironic that the weakest points of a study of Japanese management methods that has customer input as a critical success factor are determining customer needs in the human resource area and teaching the customers the tremendous value that the results of this program can offer to their organizations.

Frank Riley, *Chair*
Committee to Assess U.S.-Japan Industry
and Technology Management Training Program

Contents

List of Acronyms and Abbreviations	viii
Executive Summary	1
1 Introduction: Japanese Technology Management Practices in Context	7
Key Attributes of Japanese Technology Management, 9	
Program Objectives, 11	
2 Program Assessment	15
Research, 17	
Curriculum in J/TIM, 20	
Practical Experience, 23	
Summary, 26	
3 Creating an Academic Specialization	27
Curriculum Development, 28	
Faculty Development, 28	
University Organizational Issues, 29	
Summary, 30	
4 Outreach to Industry	31
5 Intraprogram Coordination	35
Short-Term Coordination Issues, 35	
Long-Term Network Opportunities, 36	
Summary, 37	
6 Conclusions and Recommendations	39
Program Expectations, 40	
Future Program Management Issues, 41	
Future Program Funding, 44	
Conclusion, 44	
Reference List	45
Bibliography	46

Appendix A: Pertinent Text of the 1991 National Defense Authorization Act	49
Appendix B: AFOSR Program Announcement	50
Appendix C: Cultural Relativity and the Study of Japanese Management	52
Appendix D: Second Round Program Summaries	58
Appendix E: Other Japan-Oriented Organizations in North America	66

List of Acronyms and Abbreviations

AFOSR	Air Force Office of Scientific Research
EAGLE	Engineering Alliance for Engineering Education
J/TIM	Japanese technology and industry management
MIT	Massachusetts Institute of Technology
MOT	management of technology

Executive Summary

Japanese technology and industry management (J/TIM) practices have evolved in a cultural and economic context unique to Japan. The interaction between industrial organizations in Japan, combined with established patterns of government-business relations, labor-management relations, and other economic and social relationships, has created business and economic systems in Japan that are distinctly different from Western models of corporate organization and governance. It is essential, therefore, that studies of, and training in, J/TIM employ a framework of analysis and interpretation that places these management practices in the appropriate context.

The U.S.-Japan Industry and Technology Management Training Program, established by the Congress and managed by the Air Force Office of Scientific Research (AFOSR), provides the opportunity for U.S. academics to broaden and deepen their understanding of the multifaceted sources of Japanese industrial success and to convey that understanding to practitioners in U.S. industry and government laboratories. As stated in the authorizing legislation (see Appendix A), the program is intended to "prepare scientists, engineers, and managers to learn from their Japanese counterparts by being able to work closely with them throughout their careers in government or industry" and "help keep U.S. industry abreast of Japanese scientific and technical developments and their importance." To accomplish this, the AFOSR has funded nine universities or university consortia to augment research and training in Japanese technology and management practices; to expand language training, particularly for engineering and management students; to provide opportunities for internships in Japan; and to encourage participation in the programs by government scientists and engineers. (The Request for Proposal issued by the AFOSR is in Appendix B.) The recipient universities and centers for the first three years of the program are listed below.

After the program was under way, the AFOSR asked the National Research Council to form the Committee to Assess U.S.-Japan Industry and Technology Management Training Programs to review the program's progress and to recommend steps to maximize the value of the program to U.S. industry and government. The committee has concluded that, for the program to meet the objectives of the Congress and to genuinely enhance U.S. understanding of J/TIM, a multidisciplinary approach to research, education, and training must be used, and an aggressive effort must be made to disseminate the results to industry.

1991	Massachusetts Institute of Technology
	The University of Michigan
	Vanderbilt University
	The University of Wisconsin/EAGLE*/NTU**
1992	University of California-Berkeley
	University of New Mexico/University of Texas at Austin
	University of Pittsburgh/Carnegie Mellon University
	Stanford University
1993	Massachusetts Institute of Technology
	University City Science Center
	The University of Michigan
	The University of Washington
	The University of Wisconsin/EAGLE*/NTU**

* Eagle is the Engineering Alliance for Engineering Education, a consortium of 13 engineering schools.

** NTU is the National Technological University.

The funding for this program has provided the opportunity to create a strong academic specialization in J/TIM, which would augment engineering and management education. An academic specialization in J/TIM would incorporate appropriate disciplines, including language, culture, economics, engineering, business, and management, to create an integrated, multidisciplinary academic program with the richness necessary to strengthen understanding of the complexities of Japanese technology management. Building such a multidisciplinary specialization would provide a framework for research, publications, curriculum development, and continuing education activities. Yet, making this specialization as relevant and useful as possible will require input from industry, and industry must, in turn, be convinced of the value of the program. Achieving these twin goals—creating a strong academic specialization and ensuring its relevance to the needs of U.S. industry—should guide the future management of the program.

PROGRAM ASSESSMENT

In reviewing the first eight of the programs funded by the AFOSR, the committee noted that each has a somewhat different emphasis. With some exceptions, the elements included in the programs are research, language and culture training, internships, and outreach to industry and government laboratories. In all of these areas, the committee found that the

programs are making good progress in implementing what they had proposed to the AFOSR.

Despite this progress, the committee does not believe that the individual programs have advanced as far as is needed to accomplish the goals of the overall AFOSR program. The committee noted that many of the research projects were already defined prior to the AFOSR grant and had simply been given a Japanese slant, so AFOSR funding was being used to augment existing research projects. Much of the research effort is focused in relatively few industries, such as electronics, computers, and automobiles, leaving many industries untouched. Much greater coordination among the programs is needed to broaden and diversify research efforts.

Internships are being emphasized by most of the schools, though not without difficulty. Many schools noted the increasing difficulty of placing interns in Japanese firms during the current recession there, which resulted in fewer intern placement opportunities, shorter durations of internships, and increasing difficulty in funding the interns' stays. The committee believes this situation could be improved by greater coordination of intern placements among the schools and by instituting consistent, rigorous language and technical proficiency requirements for intern eligibility. To ensure the maximum benefit from the visit, every effort should be made to select only the most prepared and dedicated students.

The primary shortcoming noted by the committee is the relative lack of attention to developing and teaching courses on J/TIM practices. Curriculum, to the extent any is in place, focuses on language training, and a wide variety of language courses have been made available to management and engineering students as a part of these programs. However, very few courses on J/TIM practices have been instituted, and few courses on Japanese culture, history, and economics have been developed outside of what might be covered in language courses. Although curriculum development has not been part of the AFOSR's Request for Proposal, and the committee recognizes the difficulty of implementing new curricula in universities, especially multidisciplinary curricula, this lack of attention raises serious questions about how much training the U.S.-Japan Industry and Technology Management *Training* Program is providing.

The committee believes that the programs are adding value by exposing more engineers and managers to Japanese language and providing more internship opportunities. But much more is possible and needed. Achieving more—specifically, creating a viable, multidisciplinary academic specialization in J/TIM—will require a great deal more cooperation and collective action than has been apparent to date. It will also require an explicit recognition of the obstacles presented by the academic culture that must be overcome, in curriculum development, faculty development, and organizational structures and hierarchies.

OUTREACH TO INDUSTRY

The committee believes that, for the overall AFOSR program to be effective, the program must be responsive to and provide value to industry, including government laboratories. Many of the individual programs have asked industry and laboratory managers

what their expectations of the programs are. In response, most of the programs have created conferences, seminars, lecture series, and part-time courses to respond to the needs of midcareer professionals. Much more is needed to gain the acceptance, even enthusiasm, of customers in industry.

In essence, this program needs to be more aggressive in marketing itself to industry and government laboratories. Program directors need to seek industry input constantly for research topics, course material, and subjects for conferences and lectures. They need to convince managers in industry that the training objectives of the program are useful. This is likely to be a long-term process, but, by constantly seeking input, producing graduates that companies find valuable, generating research results that are useful and timely, and working hard to be responsive, these programs can help to generate enthusiasm in industry.

RECOMMENDATIONS

The committee recognizes and has tried to convey throughout the report the difficulties that arise in efforts to create a new academic specialization, as J/TIM could become; the problems in achieving effective coordination across academic institutions; and the fundamental problems of marketing the benefits of studying and teaching J/TIM to U.S. industry, which remains largely ambivalent about it. None of the problems are easy to overcome, particularly given the limited resources for the program provided by the Congress. However, the committee believes that, with appropriate adjustments to the management of the program, it can be much stronger in the future.

Most of the management adjustments depend on closer coordination among the funded schools. The strengths of each should be recognized and coordinated contributions made by each to the overall research agenda, intern placements, curriculum development, and outreach efforts. The objective should be to create a strong national program, the sum of which is much stronger than the individual parts. Achieving the needed level of coordination will require changes in the approach taken so far to implement the program.

Sustained Funding

None of the awardees has had any assurance of sustained funding beyond the two-year grants awarded. The three schools that received new funding after the initial two years did so on the basis of new proposals. Although the uncertainty of congressional funding for the program makes this approach to awards understandable, the committee believes that assurance of sustained funding for awardees for a five-year period would be beneficial to their planning and implementation efforts. In particular, it would create a stronger basis for the coordination the committee deems essential to achieve long-term program goals. Sustained funding would also provide the AFOSR with a basis for stronger overall program management by making continued funding conditional on program performance, rather than proposal quality.

Performance Criteria

Receiving sustained funding must be conditional on a clear set of performance criteria. The committee recommends criteria such as:

- evidence of growing industry support, such as sponsored research;
- evidence of effective, aggressive outreach efforts;
- evidence of the general strength of the program as measured by enrollments, language proficiency of graduates, diversity of intern placements, implementation of appropriate J/TIM and culture courses, and effective placements of graduates; and
- demonstrated willingness to cooperate with other awardees.

The implementing of such performance criteria by the AFOSR should be planned carefully to give awardees opportunities to make the necessary modifications in their programs, since these criteria were not included in past requests for proposals.

Central Coordination

To achieve the needed level of coordination among all the awardees, the AFOSR should consider reserving some small portion of the funding for coordination activities. These might include a central intern placement office in Japan, funding a permanent director from academia to manage the overall program, and funding frequent meetings of the individual program directors.

Future Program Funding

Uncertainty in the level of congressional funding for the program each year has been detrimental to progress. This situation has been complicated by the reduction of funding in fiscal year 1994 from \$10 million to \$5 million. Although it is difficult to judge the level of funding necessary to ensure a viable program, the committee believes that \$5 million is probably insufficient to sustain all of the nine awardees currently being funded. That amount would result in grants of slightly more than \$500,000 per awardee to pay for faculty salaries, institutional overhead, and student support. One program director has estimated that these and other program costs amount to \$40–45,000 per student, so \$500,000 will support very few students. Reduced funding will increase pressure on awardees to find alternative funding sources and is likely to force the AFOSR to cut the number of programs funded.

CONCLUSION

The committee has outlined an ambitious plan for the future of the AFOSR's U.S.-Japan Industry and Technology Management Training Program. Obstacles to fulfilling these ambitions are many, ranging from indifference on the part of much of industry to rigid academic organizations and inadequate resources. The committee is convinced that these obstacles can be overcome, but doing so will require stronger funding commitment from the Congress, appropriate incentives from the AFOSR, well-defined performance criteria, and clear expectations of what the funded universities should achieve and how the total program will operate. The potential benefits to U.S. industry are certainly worth the effort.

Introduction: Japanese Technology Management Practices in Context

The Japanese business system is perceived to be an alternative way to organize and manage corporate relations. That is, Japanese business organizations are distinctly different from the Western models of corporate organization and governance in large firms, where vertical integration, horizontal diversification, growth by merger and acquisition, and shareholder interests appear dominant. The Japanese business model may be emerging as one of the ideal types in Asia, and if the trend holds, Asian forms of capitalism may emerge in apposition to Western forms of capitalism. The Japanese business system represents an organizational innovation of local design but global importance and therefore must be more fully understood by U.S. industry.

Industrial organization in Japan is anchored by three modal forms of organization (Fruin, 1992):

1. *Focal factories* are organizationally strong, because they are administratively robust and are functionally important, because they integrate upstream and downstream activities in the value chain.
2. *Modern corporations* are structurally complex and not widely diversified in activities. Corporations mediate, negotiate, and manage the linkages between internal organizational units and the hundreds and thousands of outside subsidiaries, affiliates, and suppliers that typically cluster around large firms in Japan.
3. *Interfirm networks* are the means whereby great depth and breadth of organizational capability may be mobilized through cooperative strategies. These networks tie together firms through cooperative strategies and mutually beneficial patterns of interaction.

Seen as a whole, the interrelations of factory, firm, and interfirm network create a business system that is characterized by interorganizational competition and cooperation and is singular in structure and internal logic.

The emergence and development of this type of business system is grounded in the history of industrialization in Japan and in the efforts of countless Japanese firms to survive and succeed in the midst of that history. In a highly competitive, global economy, the Japanese business system of interorganizational management that unites factory, firm, and interfirm networks in cooperative yet competitive ways may be seen as an organizational alternative to Western forms of corporate-capitalist endeavor.

This simplified characterization of the Japanese business system begins to indicate the complexities of studying Japanese industry and technology management practices and implementing them in U.S. companies. In order to study industry and technology management practices in Japan and to place them within a larger context that will allow for cross-national comparison, both academic and industrial studies need to employ a framework of analysis and interpretation that focuses on industry and technology management practices as part of a larger social and economic fabric. This fabric includes government-business relations, labor-management relations, and intercorporate and intracorporate organizational relations. These relationships are features of every advanced industrial economy and, quite obviously, exert a profound effect on how industry and technology practices evolve in different national settings. Without tying the study of industry and technology management practices to these larger institutional relationships, it is impossible to make meaningful cross-national comparisons. And without meaningful cross-national comparisons, a desire to strengthen the U.S. technical base by transferring and implementing appropriate industry and technology management practices from Japan will be doomed at the outset.

In effect, industry and technology management practices must be seen as elements of the total Japanese economic system, which includes not only the business system of factories, corporations, and interfirm networks, and the various social and economic relationships noted above, but also accepted models of corporate governance and established modes of corporate growth, merger, and acquisition. Although aspects of the business system may be studied in isolation and even transferred overseas, parts of a larger economic system are likely to be misunderstood out of context. They will be poorly transported across thousands of miles of social space and cultural time. Thus, while there is real value in attempting the overseas transfer and diffusion of industry and technology management practices, it makes good sense to understand the complexity of the task. Industry and technology management practices are deeply embedded in social behavior and organization; it is difficult to dislodge them from that context and even more difficult to transfer them abroad.

The difficulties of cross-cultural transfer are not absolute, however. Individuals and societies have been borrowing from one another for thousands of years. But the ease and speed of the technology and organizational transfer process should not be overestimated, and the complexities of identifying just what is to be transferred and how transfer will be effected should not be minimized. Indeed, the most important lesson may be just that: cross-cultural technical and organizational transfer is possible but decidedly difficult. (Appendix C summarizes the evolution of Western understanding of Japanese culture and the culture's impact on management.)

This assessment of the cultural context for the transfer of Japanese industry and technology management practices makes clear that only through a consistent, long-term examination and analysis of the total Japanese economic system can a strong understanding be gained of the sources of Japanese industrial and technical success. Much is already known about Japanese manufacturing management practices. Just-in-time production, quality circles, total quality management, and continuous improvement are just a few of the modern management practices implemented by the Japanese. Though many of these practices were originally conceived in the West, relatively few U.S. companies have had strong success in

implementing them; even many Japanese firms have had difficulty using these practices in their plants in the United States. Although the practices are known, they are not fully understood in the way that could result from a rigorous, multidisciplinary body of research and analysis.

KEY ATTRIBUTES OF JAPANESE TECHNOLOGY MANAGEMENT

The Air Force Office of Scientific Research (AFOSR) U.S.-Japan Industry and Technology Management Training Program provides the opportunity to develop the needed understanding of the multifaceted sources of Japanese success in world markets. Its unique focus is to study the management of technology, rather than just management or technology as individual topics. U.S. managers have limited understanding of how Japanese companies manage technology, particularly leading-edge technology applied to world-class products and manufacturing processes. What U.S. companies need to adopt from the Japanese is not technology per se, but rather their adaptability and their ability and persistence in pursuit of continuous learning. These are the key sources of Japanese success.

There are three principal aspects of Japanese management of technology: (1) continuous improvement, (2) robustness (i.e., minimizing performance variability around a target), and (3) market responsiveness. U.S. companies need to understand how Japanese managers interact with and learn from technological, economic, and other factors, both inside and outside of their company. The idea of robustness in Japanese management evolved following the quality improvements that fueled much of the Japanese market success in consumer goods during the last three decades. The fast time-to-market achieved by some Japanese companies suggests their effectiveness is related to something other than technology. The coupling of research to development to manufacturing processes to markets is a complex process that must be understood in detail. U.S. universities and companies do well with the earlier part of this development stream; the fact that Japanese companies excel at the downstream part is the major reason for studying and teaching Japanese industry and technology management practices.

Continuous Improvement

Continuous improvement of products, manufacturing processes, worker skills, and other technological and production factors is a hallmark of Japanese management and contrasts sharply with standard U.S. practice. Good Japanese managers will continuously seek supporting data from the marketplace to discover which technology best answers the perceived or latent needs of the intended customers. They then link the knowledge learned in the market to their manufacturing and research and development efforts. Note that the "market" may be a different function within the business and the "customer" may be a worker on the production line, so markets both external and internal to the firm are sources of knowledge.

This approach to learning makes discovery of mistakes an opportunity for improvement rather than something to be denied. The result is a process of collective learning that integrates all levels of the organization.

U.S. managers, on the other hand, typically seek concrete goals for projects (usually internally generated). Once they meet these goals, they consider the job done. No rationale or support exists for seeking further improvement. Because the company's technological, cost, and other goals are defined more by internal demands than external market factors, many U.S. managers attempt to force into the marketplace technology that is not ready or that may be inappropriate for use in its present form. One example is the failure of gas turbine engines for automobiles in the 1960s and 1970s because of poor vehicle performance and cost; another example is AT&T's picturephone in the 1980s.¹

Japanese executives are often astounded at the breadth and depth of technology that is developed in the United States only to be abandoned or brought to market prematurely or haphazardly. While U.S. laboratories invent a remarkable diversity of new technologies, many of these do not achieve market success for the company that developed them. This situation may be due to an internal focus on technology development that puts a premium on inventing one's own solutions instead of having a systematic process for reviewing, on a continuous basis, all technologies that could be used in the specific situation.

Sharing research and development resources and risks with suppliers is another means used by some Japanese companies to expand beyond their own walls. This requires long-term partnerships between original equipment manufacturers and a select group of capable and resource-ready suppliers. These types of partnerships are starting to appear among leading U.S. companies. Some contend that "understanding the *kaisha kyodo-tai* (the communal business group) is a key to understanding Japanese-style management" (Kawamura and Sone, 1993). Properly focused research could develop understanding of how these linkages work in Japanese industry. These characteristics of a Japanese organization reinforce the point that learning how the Japanese increase their effectiveness may be more important than learning their technology.

Robustness

The coupling of design of the product and processes of manufacturing early in the development cycle may provide additional insight into how the Japanese manage technology. Many laboratories in U.S. companies do not consider quality assurance to be part of their mandate and thus may release premature technology into the product development process. U.S. companies often need to improve their understanding of the effects that interactions between product design and process designs have on quality and cost of manufacture.

In recent years, many U.S. companies have made progress in unifying, under the direction of one top-level manager, the efforts of many parts of their organizations in

¹Japanese companies also have their failures in deploying market-ready technology. For example, four-wheel steering has had little market penetration in the United States after being introduced with great fanfare in the 1980s.

activities called simultaneous or concurrent engineering. Although helpful, these concurrent engineering teams still leave some production startup and process development problems that need to be resolved during product launch. This is costly, and may result in products with low quality and poor functionality. Ideal coupling of the design and production process would mean the development of technology to the required level of "robustness" before detailed design and production startup. Because the outcome would be more predictable, the results would be reduced risk, improved confidence, and shorter cycle times for product development.

Taguchi has led efforts by the Japanese to define the variations in process, so countermeasures are translated into robust designs that meet or exceed market requirements (see Taguchi and Wu, 1979). Toyota has publicized its development of a model that predicts boundaries that occur in metal forming, so that the design of styled, formed parts can take place with minimal risks and reduced time-to-production.

Market Responsiveness

The relationship of technology to the perceived business opportunities in world markets raises questions that have been largely unanswered about Japanese companies: Do successful companies have a better process for adapting technology to markets? Do they have a better method of defining the level of technology needed for markets? Do they have better methods of utilization of technology within their own companies, so they can deliver products more quickly to markets?

The accomplishments of Japanese industry in the camera, consumer electronics, and automobile markets have been chronicled by the business press. Now fears are expressed that they may dominate in emerging markets like semiconductors or biotechnology, as they devote more of their resources to basic research in those areas. How do Japanese companies go about dealing with the process of technology development? Is this process driven by the quest for knowledge or is it driven by the intended market?

There is evidence that some U.S. companies do not understand the significance of what can be learned about technical management from the Japanese. There are many Japanese companies that successfully stayed alive through fierce competition, and these companies tend to keep their survival-mode attributes even after winning the survival battle in the market. They continue to pursue further improvement persistently. U.S. technology managers need to learn the effect this has on the performance of successful Japanese companies and how to apply continuous improvement in U.S. industry.

PROGRAM OBJECTIVES

The committee is convinced that the U.S.-Japan Industry and Technology Management Training Program can provide a much-needed boost to U.S. understanding of Japanese management practices, as well as of the organizational, cultural, historic, and economic factors that create the environment for Japanese success. By conducting well-structured

research in Japanese industry—not only in Japan but also in Japanese plants in the United States, Europe, and elsewhere in Asia—and by training a new cadre of U.S. scientists, engineers, and managers in Japanese technology management practices, this program can create an enduring cycle of improved understanding of the total Japanese business system.

The committee believes this objective is what the Congress had in mind when it created the program. Based on the language in the authorizing legislation (see Appendix A), the objective of the Congress in creating the U.S.–Japan Industry and Technology Management Training Program is to

prepare scientists, engineers, and managers to learn from their Japanese counterparts by being able to work closely with them throughout their careers in government or industry. . . . the program should be structured to help keep American government and industry abreast of Japanese scientific and technical developments and their importance.

(U.S. House of Representatives, 1990)

In other words, the Congress has provided financial resources to strengthen U.S. knowledge about Japanese industry and technology practices and to disseminate that knowledge to the national scientific and technical community.

In considering this objective for the overall program, and in reviewing the activities of the first eight awardees, this committee has identified two major goals that AFOSR, as the program manager, should strive to achieve. The first addresses the academic community receiving the funds. The funding authorized by the Congress has provided the opportunity to create a strong academic specialization in Japanese industry and technology management (J/TIM). An academic specialization in J/TIM would incorporate appropriate disciplines, including language, culture, economics, engineering, business, and management, to create an integrated, multidisciplinary academic program with the richness necessary to strengthen understanding of the complexities of Japanese technology management. Building such a multidisciplinary specialization would provide a framework for research, publications, curriculum development, and continuing education activities. It would provide much-needed focus for a wide range of activities now typically scattered across academic departments, which would facilitate the emergence of a comprehensive program of study. Research and education within the J/TIM specialization would build on present knowledge of Japanese practice, integrate it with what is known about Western technology and industry management, keep tabs on the evolution of technology management practices in Japan and the West, and maximize the usefulness of the results to U.S. managers.

The committee's argument for creating an academic specialization is based on the need to ensure that J/TIM is not just an engineering or business school subfield and not simply an internship and Japanese language training program for engineers and business students. As this chapter has described, there is much to learn from Japanese technology and industry management practices. J/TIM should be an integrated, multidisciplinary area of research, education, and outreach, using a rich array of resources from across university departments.

This objective still leaves room for flexibility in implementation, however, and the committee does not endorse one approach over another. The Stanford approach of housing

the J/TIM program in the engineering school; the Berkeley approach of housing it in the business school; and the Massachusetts Institute of Technology (MIT) approach of creating a separate program, the MIT Japan Program, are all legitimate mechanisms for managing J/TIM activities. Each is arguably best for the culture and resources present at each institution. Some schools focus on training undergraduates and others, graduate students. Because an academic specialization in J/TIM does not imply a degree program, but more likely a certificate to provide recognition for the additional skills achieved by the students, it can focus on the different levels of students in the different settings to best take advantage of the resources at each school.

The second goal addresses the needs of U.S. industry and technological enterprises. To be truly successful, the AFOSR program must demonstrably help U.S. firms and laboratories improve their technology management practices. Such a goal requires that the university programs emphasize outreach to industry to maximize their responsiveness to industrial needs. Research, education and training, internships, and other activities funded through this program should reflect the needs and constraints of U.S. manufacturers and government laboratories. Emphasis must be given to maintaining industrial relevance; taking steps to provide educational programs for midcareer scientists, engineers, and managers; and making efforts to channel research findings quickly to constituents in industry.

The committee recognizes that achieving these two goals will be difficult. Success depends on maximizing the effective use of limited resources across the program, on generating much stronger industrial interest and support than has been evident to date, on overcoming barriers within the academic culture itself to creating multidisciplinary specializations such as this, and on understanding the relevant cultural issues that determine how effectively Japanese management practices can be transferred to U.S. industry. The committee addresses all of these issues in the following chapters.

2

Program Assessment

The AFOSR program is unique in that its focus is on J/TIM. Although many universities have Japanese language and culture courses, and perhaps even academic majors in Japanese, these courses are typically part of humanities programs based in the Asian Studies department. By focusing on training engineers, scientists, and managers, the AFOSR J/TIM program can create a new academic specialization that combines traditional Japanese studies with the technical training provided in engineering and business schools. Each of the schools currently being funded by AFOSR has the resources and talent needed to achieve this goal. Although the mechanisms being used vary widely among the awardees, each is making progress in certain areas. The universities and centers receiving awards during the first three years of the program are shown below. (For a summary of the programs of the first four awardees, see the committee's interim report [NRC, 1993]; Appendix D summarizes the programs of the 1992 awardees.) In almost every case, the resources of Asian studies departments in language and culture are being integrated with engineering or management schools. In some cases, courses in various aspects of Japanese management practice are beginning to be included in the curriculum. And relevant research is being performed to build the knowledge base, strengthen the curriculum, and support faculty. This pattern of program elements has become fairly consistent across almost all of the awardees, though the relative emphasis varies somewhat according to each school's history and resource availability.

There is more variation across the schools in terms of the issues and audience each is targeting. Some of the universities manage this program through the engineering school (e.g., Stanford); others through the business school (e.g., University of California, Berkeley); and others create independent programs, separate but linked to the engineering and business schools (e.g., MIT). Furthermore, many of the schools have focused their programs on graduate students (e.g., Stanford and Berkeley); others on midcareer professionals (e.g., New Mexico); and still others on a mixture of both of these, in addition to more emphasis on undergraduates (e.g., MIT and Wisconsin/EAGLE [Engineering Alliance for Engineering Education]). These different levels of student are the primary "product" of the programs, and how much emphasis is placed on each type of student tends to dictate the priorities in each aspect of the program. The committee explicitly discussed this issue of program content and program participants. The committee's consensus is portrayed graphically in Table 2-1.

1991	Massachusetts Institute of Technology
	The University of Michigan
	Vanderbilt University
	The University of Wisconsin/EAGLE*/NTU**
1992	University of California, Berkeley
	University of New Mexico/University of Texas at Austin
	University of Pittsburgh/Carnegie Mellon University
	Stanford University
1993	Massachusetts Institute of Technology
	University City Science Center
	The University of Michigan
	University of Washington
	The University of Wisconsin/EAGLE*/NTU**

* EAGLE is the Engineering Alliance for Engineering Education, a consortium of 13 engineering schools.

** NTU is the National Technological University.

TABLE 2-1 The Program Output Model*

Program Content	Participants					
	Young Technologist	Technology Manager	Middle Manager	Japan-ready professional	Strategist/Senior Manager	University Faculty
Technology Management	3	5	4	4	5	3-5
Culture	2	3	5	4	4	3-5
Practical Experience (Internships)	5	3	1-2	1-2	0	3-5
Language	4	3-4	3	3	1	3-5

* This matrix describes the importance placed on various key elements of training provided to program participants. The Program Content reflects the pattern of that has emerged in the schools funded by the Air Force. The numbers indicate the level of emphasis each of these parts should receive for different types of program participant: 5 signifies the heaviest, 1 the lightest (0 = not applicable). The rankings are row relative only.

In effect, the committee is arguing that the emphasis placed on different aspects of each program must reflect the mix of participants and their changing needs at different career

stages. To illustrate, younger participants should receive more language training than older managers, not only because they tend to have greater aptitude to learn the language but also because they should realize greater benefits from their language ability as their careers progress. In contrast, young technologists have little experience in management situations and therefore are not likely to benefit as much from rigorous comparisons of different technology management practices as more senior managers are. Clearly, this assessment of the types of participants the programs should be addressing and the emphasis placed on the training each type receives has implications for the committee's assessment of the program as a whole. Although recognizing that variations in the different awardees' programs are due to the strengths of each of the schools and the degree to which Japan-related programs existed before the Air Force awards were made, the committee believes that a more consistent, focused approach to research, target audiences, and marketing efforts is desirable. Expectations for language training and internships need to be realistic. Although the programs have gotten off to a good start—all the awardees have made progress in implementing the plans described in their proposals—the committee believes that enough effort and money has gone into the program so far to begin to identify a desirable evolutionary path that will meet the dual goals of creating an academic specialization in J/TIM and improving U.S. technology management practices.

To address the relevant issues, the following sections will provide the committee's assessment of the programs' research, curricula in J/TIM, language and culture training, and internships, particularly as these program elements relate to creating a strong academic specialization in J/TIM.

RESEARCH

No academic field can build without a continually renewed, solid base of knowledge. Research is essential to the long-term strength of the J/TIM programs. It develops the expertise at each of the programs and has the potential to provide industrial participants with timely information, thereby providing a basis for industrial support for the programs. Research results also are essential to develop case studies and other curricular material.

Several of the awardees have placed a great deal of emphasis on research, and the range of topics being studied is impressive. Across all of the awardees, research projects can be grouped into three broad categories:

1. *Industry-specific technology assessments* are favored by programs managed by the engineering school. For instance, Stanford has research projects examining the optoelectronics, semiconductor, flat-panel display, and advanced computing industries in Japan.
2. *Studies of management practices* are favored by programs managed by the business school. For instance, the University of Michigan is focusing on various aspects of the automobile industry, such as approaches to product development and the role of suppliers, on management of global manufacturing networks, and on technology strategies in the Japanese pharmaceutical and medical device industries. Berkeley expanded its research

program in management of technology with projects in the semiconductor and software industries, plus projects in human resource management in high-technology manufacturing.

3. *Policy-related studies*, such as market access, technology transfer, and defense policy studies, are favored by schools with new or separate Japan programs. An example is MIT's large research project examining U.S.-Japan technology cooperation in defense industries. Another example is New Mexico's planned study of U.S.-Japan technology transfer policy.

All of these research efforts have merit. Taken together, this research should provide a basis for strengthening the curricula of the program, build faculty expertise, and improve U.S. companies' knowledge of specific technological developments. Several of the research projects are connected directly to sponsoring companies in the schools' regions. New Mexico, for example, is emphasizing sponsored research and has already completed a project for Sandia National Laboratory on emerging energy technologies in Japan. Sponsored research ensures that specific needs of client companies and laboratories are known and addressed, which helps to meet a major goal of the program.

Despite the merits of the research being performed, the committee believes that research efforts could be improved by more coordination across the awardees and better focus on those aspects of Japanese management practices that appear to be the main sources of their success. Several shortcomings in the program's research efforts are identified and ideas for overcoming them offered.

Relabeling

One of the shortcomings seen by the committee is that, in several cases, AFOSR funding has been used to add a Japanese context to previously existing research efforts. Research topics had already been defined, the research itself had already been started, and the AFOSR funds were seen as an opportunity to include Japanese site visits and companies in the research process. Relatively few research projects appeared to have been created as a direct result of AFOSR funding; the primary exception is the New Mexico program, which was started from scratch with the AFOSR award. This situation of subsidizing preexisting research projects made it very difficult for the committee to judge just what the Air Force was getting for its money.

Duplicative Research

A second shortcoming perceived by the committee is too much duplication in research emphasis across awardees, especially in the areas of electronics and semiconductors. Part of this emphasis is due to the concentration of these industries around such awardees as Stanford, Berkeley, MIT, and New Mexico and therefore may be relatively unavoidable if awardees are responsive to their local industrial base. And, of course, these industries are a major part of Japanese success. However, in a program as small as the AFOSR program, the level of emphasis on these few industries creates too much redundancy in the total

program's research effort and neglects other industries. Michigan works in the automotive industry, and New Mexico has done some work in energy technologies, but important industries such as aircraft and aircraft engines, machine tools and other capital equipment, biotechnology, and materials science are not being investigated to an extent commensurate with their importance in either the Japanese or U.S. economies.

The committee recognizes that this issue is difficult to address, given the interests of participating faculty, the need to involve local industry, and the differences in technology management practices across different Japanese companies. Some degree of duplication of research may be desirable to begin to capture the many idiosyncracies of how technology is managed in Japan, but strong coordination among researchers is essential to achieve these benefits. For instance, explicit efforts to compare and contrast product development in automobiles, software, and computers, based on the results of several research projects being funded by AFOSR, should be required. As more industries and, therefore, companies are included in the research efforts, such coordination should result in an especially rich understanding of J/TIM practices.

Gaps

A third shortcoming is the lack of attention to several aspects of J/TIM that the committee perceives as ripe for research. Perhaps the most obvious gap in research is the relative neglect of the experiences of Japanese transplants in the United States. Although some of the programs have researched, or have plans to research, transplants, notably Carnegie-Mellon/University of Pittsburgh, the insight that could be gained from examining their experiences has hardly been tapped. Just in the automotive transplants, there is invaluable knowledge to be gained by examining the experience of implementing Japanese management practices in unionized U.S. plants. For instance, what union rules impede the use of quality circles or team-based work cells? How does the legal environment impede supplier relations? Which efforts have worked and which have not? What have the companies done to adapt? If the focus of this program is really Japanese management of technology, then these Japanese experiences in the United States, mixing industries, companies, and sizes of companies, need to be carefully examined.

This research could be further enriched by including studies of Japanese investments in other countries, particularly those in Europe and southeast Asia. Given the importance of culture in applying and modifying J/TIM practices, the degree to which Japanese firms have adapted their practices and modified their expectations in different countries deserves significant research attention.

Other areas that deserve greater research emphasis are the success factors identified in Chapter 1: continuous learning, robustness, and market responsiveness. Current research projects in product development, technology transfer, and human resource management begin to address the relevant management practices, particularly as they are applied in different industries. The committee is concerned, however, that too little research is focused on the management of technology, as opposed to management or technology as separate topics. One specific area on which the committee believes more research should focus is

Japanese failures, and the response to those failures. There are many examples of Japanese failures in product development, government-led research projects, and industrial policy. Studies of the assumptions and decisions that led to the failures, and the learning processes that occurred after the failures, would convey important lessons to U.S. managers and policy makers.

Summary

The aim of the research efforts funded by the AFOSR program should be to strengthen U.S. industry's understanding of J/TIM practices, in all their cultural and corporate contexts. Many of the existing research efforts funded by AFOSR contribute to this goal. In the context of each individual school's areas of expertise, current research efforts make sense. Mostly, they build on existing efforts and faculty strengths and therefore are effective resource expenditures for the short term.

In the longer term and across the total AFOSR program, however, the committee believes there is room for improvement. Although a truly comprehensive research agenda is not possible given the scale of this program, there are opportunities to improve coordination, fill gaps, and focus research efforts to support the emergence of an academic specialization in J/TIM. Research efforts should be viewed from a total program perspective, so that all of the funded schools could build on and profit from the variety of industry- and management-related expertise residing in each school. Explicit cooperation in defining research projects and coordination to ensure the broadest possible industry and company coverage are essential. Emphasis on sponsored research is also important to ensure its relevance to U.S. industry.

CURRICULUM IN J/TIM

A consistent, well-defined curriculum is a central aspect of a strong academic specialization in J/TIM. Given what is already known about J/TIM practices, there is a basis for implementing such a curriculum. Unfortunately, this is the area in which the programs funded by AFOSR appear to be weakest. Instead of providing courses in J/TIM, most of the course material is in language and culture, with the objective of preparing students for internships.

J/TIM Courses and Seminars

Only a few, new, for-credit J/TIM courses have been created or proposed as a result of the AFOSR grant. The most aggressive program has been at the University of Texas at Austin where five new or wholly revised semester-long courses have been or are being developed with the help of the AFOSR grant. These include "Marketing Advanced Technology," "Intercultural Technology Transfer," and "Managing the Product Cycle." The

University of Michigan has created a new course on Japanese Technology Management that covers important Japanese practices such as concurrent engineering, technology deployment, organizational learning, and approaches to applied research and development, all with contrasts to U.S. practices. The University of Wisconsin offers a course in Science and Technology in Japan and has proposed creating a new course in Management of Technology in Japan, which would also be carried by the National Technological University (NTU). Finally, the University of New Mexico has proposed creation of several new courses in U.S.-Japan comparative technology policy; production and operations management; service operations management; the history of U.S.-Japan relations; and computers in manufacturing, with cases from Japanese companies. Although a start to J/TIM curriculum development, these few courses do not span the breadth of subjects and information that students at all levels should have in order to understand the unique elements of J/TIM and the conditions in which those elements are implemented.

This relative lack of attention to new courses in J/TIM is not necessarily an indictment of the programs, particularly when creating such courses was not addressed in their funding proposals. Obviously, most of the schools have engineering and management courses, at both the graduate and undergraduate levels, that include important aspects of J/TIM. Most have programs in management of technology (MOT). Berkeley's approach has been to use the AFOSR funding to augment its certificate program in MOT. Berkeley's MOT certificate is available to students as an adjunct to a master's degree in business or engineering. Core courses in the MOT certificate program are "Management of Innovation and Change," "Operational Management of Technology," "Management of Technology Seminar," and "Intelligent Manufacturing Systems: Technology and Management." A large number of MOT-related courses are also available in the business and engineering schools. Though there does not appear to be much Japan-specific content in most of these courses, the emphasis seems to be on teaching world-class MOT practices, regardless of their source.

Although little attention so far has gone to creating specific J/TIM courses (with the exceptions noted above), each school has created new seminars, workshops, and conferences using AFOSR funds. Stanford has created a new fall-quarter seminar on Japanese manufacturing and technology research and development that uses speakers from both U.S. and Japanese companies and universities and a new weekly seminar series on Japanese technology research and development and management that uses speakers primarily from Japanese firms and government laboratories. The University of Texas has held seminars on topics such as "Japanese Distribution Systems," "Japanese Information Sources," "Bridging the Culture Gap," and "Japanese Manufacturing." Other schools have created similar workshops and conferences, primarily as part of their initiatives to reach midcareer technologists, managers, and laboratory personnel.

Language and Culture Courses

In describing their curricula for this program, virtually every school emphasized the extent to which language training has been made available to engineering and management students. In most cases, the programs draw on language courses already available in Asian

studies or language departments. In many cases, AFOSR funds have been used to augment language faculty, particularly to add experts in technical and business Japanese, and to add new courses, usually in advanced technical Japanese. Most schools also offer some form of intensive language training in Japan, typically during the summer for eight to ten weeks; the EAGLE program is a good example, in which upcoming seniors spend a summer in Japan for language training and cultural instruction.

A single, consistent approach to language training, and consistent expectations for the language capability of graduates, is difficult to perceive. While every school has extensive language training available, there remains a range of opinions on how much language instruction is realistic to expect from different students. Courses range from intense 25-hour-per-week courses to part-time and weekend courses aimed at basic understanding of words and sentence structure. The consensus seems to be that the first is appropriate and possible for undergraduates, particularly humanities students, and the others are right for graduate engineering students and part-time, midcareer students. Other types of students, such as management students (both undergraduate and graduate), would be expected to go beyond basic conversational Japanese to learn more technical and business language.

This ad hoc approach to language training conforms to the committee's view of what it is realistic to expect different students to learn (as reflected in Table 2-1). For a language as difficult as Japanese, the time required to progress beyond a social conversational level is substantial. A minimum of three to five class hours per week, plus at least that much time out of class, is required to make steady progress in technical Japanese. Requirements as heavy as these on top of a rigorous technical curriculum are likely to dissuade students from participating in the program. Therefore, the approach that seems to be emerging, of rigorous language training for a few students; less rigor but more technical emphasis for most students; and basic reading and speaking for others, especially midcareer students, seems to be valid.

An approach that is not being rigorously pursued by the awardees so far is to offer courses in Japanese history and culture separate from language courses. New Mexico has created nonlanguage courses on topics such as intercultural communication, cross-cultural organizational systems, and technology and social change. Stanford has an introduction to modern Japan course, and Michigan offers a course on "Japanese Culture and Management of Technology." Other awardees offer seminars and short courses on various aspects of Japanese culture, particularly as it relates to management practices. However, it appears that most of the schools rely on language courses to convey cultural knowledge. More emphasis on courses in culture is needed, not only because of the close relationship of culture and business but also to spark student interest and to prepare the student for subsequent language training.

Given this assessment of the various approaches to language and culture training, a few key points deserve emphasis. First, students who want to participate in internships in Japan should be required to meet rigorous language requirements. The intern should have proficiency not only in conversational Japanese, to be able to function in Japanese society, but also in the specific technical area engaged during the internship. Technical reading and writing capability, together with strong speaking ability, is virtually essential to interact well with technical colleagues and to maximize the learning process provided through the

internship. The suggested language requirement implies that candidates for internships should be carefully selected, that eligibility for an internship be determined at (roughly) the end of the first year of participation in the program in order to judge language ability, and that the internship itself become the incentive for technical students to devote the time to language training.

Second, the committee believes that everyone who participates in the program, regardless of age or professional experience, should receive some language training, mainly because of the links between Japanese language and culture. It is widely thought that Japanese is a language that is closely connected to its nation's culture (Jordan and Lambert, 1991). Given that culture is a critical aspect of J/TIM (see Chapter 1), culture cannot be well understood without some foundation of language capability.

Third, serious approaches to teaching Japanese must have a way of measuring success. The College Board Achievement Test is now available for Japanese language testing and could serve as a standard proficiency test. Alternatively, the AFOSR program could develop a series of proficiency tests, shared by all the awardees and targeted at different levels of participant.

Fourth, awardees should be encouraged to experiment with different approaches to teaching Japanese language, with the goal of achieving the greatest fluency with the most flexible approach. Already, intensive summer courses and weekend courses are being used, the NTU is broadcasting language courses for distance learning, and several schools are using new audio-visual and multimedia technologies. Results using various approaches need to be captured and successes shared across the total program.

Finally, culture should receive more emphasis in the programs' curricula apart from language courses and J/TIM courses. While a few schools have implemented such courses in English, and most schools offer seminars and workshops that provide participants with insight into Japanese cultural nuances, in general this area is not receiving the attention it should. Culture study is not just an adjunct to language training, but should be woven through all aspects of the programs' curricula and research efforts. Creative teaching approaches could be used in this area, such as the role-playing exercise MIT has developed on CD-ROM (compact digital disk, read-only-memory) which introduces the student to the importance of relationships in Japan (Gercik, 1993). Another approach is the lecture series at Pittsburgh/Carnegie-Mellon that offers discussions on a wide range of culture-related issues; these are offered in the evening to allow local business managers as well as students to attend.

PRACTICAL EXPERIENCE

Each of the schools funded by the AFOSR puts considerable emphasis on placing students in internships in Japan to gain experience in a specific science, engineering, or business environment. All of the program directors have strongly supported internships as the only mechanism for providing students with in-depth experience of Japanese practices and technology. The directors argue, and most of the committee agrees, that, in addition to accelerating the language learning process, internships provide considerable long-term

benefits, such as the formation of long-term relationships, the globalization of business outlook, greater awareness of best practice, and considerable shortening of the time needed to stay abreast of Japanese technological developments. These benefits respond directly to the objectives of the Congress in creating this program and certainly justify the efforts each school makes to generate strong intern placements.

However, the committee also has a few reservations about internships, which center on their implementation more than their intrinsic value. To realize their value, interns must be matched well with their placements. And they must be well prepared, in language skills, social skills, and technical knowledge. Without these conditions, the intern probably will not learn much from the experience, other than greater language proficiency, and will not be positioned to build on the experience in future studies and work endeavors. These conditions, therefore, demonstrate the need for thorough research and planning of intern placements and rigorous selection of intern candidates.

The committee recognizes how difficult it is to meet these conditions and still place a significant number of interns. Despite the emphasis placed on internships, a majority of the schools noted difficulties in finding appropriate placements. For the most part, the programs find internships on a "catch as catch can" basis, dependent largely on personal relationships with Japanese managers or, in some cases, with U.S. managers whose firms have Japanese operations. Some programs are better positioned to find internships, such as Stanford with a permanent office in Japan or MIT with ten years of experience, but even these schools noted the increased difficulty of finding placements during the current Japanese recession. One result of this ad hoc approach to internships is that the same companies in Japan may be approached by several schools, thereby diminishing the chances of success for any one school. As a result, several program directors endorsed the idea of stronger coordination among the schools in intern placements, even perhaps using a central office in Japan for the purpose or assigning this responsibility to an overall program director.

A ramification of the current, uncoordinated approach is that it presents a confusing picture to potential Japanese sponsors. From their perspective, it can be difficult to discern the difference between the interns in this AFOSR program and those in other programs, such as the U.S.-Japan Manufacturing Technology Fellowships administered by the Society of Manufacturing Engineers for the Department of Commerce. In fact, the University of New Mexico reported that Japan's Ministry of International Trade and Industry has requested an overview of the entire scope of the AFOSR program's internships and other internship and fellowship programs in order for it to do some long-term planning and budgeting.

Budgeting is another difficult issue in internships. In the past, the typical pattern has been for the host company to provide financial support for the intern, at least some minimal living stipend. During the current recession, companies have been less willing to fund the interns, which makes placements more difficult. One result may be a tendency to shorten the length of stay. For instance, MIT has sought year-long internships in the past but may be forced to accept three- or six-month internships in the future. Another result is that more program funding must go toward supporting interns, which also has the effect of shortening the duration (in order to afford more student participation) and which reduces the funds available for other aspects of the program. The Pittsburgh/Carnegie Mellon program

finances the entire intern visit including the cost of living while in Japan. Although this approach limits the number of intern placements, it does offer the advantage of attracting bright engineers who would not otherwise get involved in Japanese study by offering the paid internship as an incentive to participate in the program.

Given these difficulties in generating appropriate internships, and the committee's view of the need to select interns and placements carefully, there are a number of steps that could be taken to improve the process. First, the AFOSR should strongly consider funding a central office in Japan to organize and coordinate internships for the entire program. Although some schools with long-standing relationships in Japan may find this approach undesirable, the majority of programs seem to be having sufficient difficulty in intern placements to welcome such a coordinating office. This central coordinating office would work with the funded universities to build on their existing contacts and to develop further linkages with organizations in Japan. It would be better positioned to determine the nature of potential intern placements and which companies and situations are best suited for different types of interns—business managers or engineers, undergraduates, or graduates. And it would be well positioned to assist individuals in residence in Japan and to provide and compile information needed to assess the quality of the experiences in Japan. A central office in Japan would have the added effect of reinforcing the government backing of the program, thereby potentially raising the stature of these internships to a level similar to the Manufacturing Technology Fellowships.

Second, strict eligibility requirements should be imposed on potential interns, at least those funded by AFOSR. They should be required to meet rigorous language proficiency standards, be technically knowledgeable in the field relevant to the internship, and preferably have some practical experience in U.S. industry in order to understand better the differences in a Japanese environment. Such requirements are likely to reduce the number of eligible interns to better match supply and demand in the current recessionary environment in Japan.

Third, for students who are not able to meet these requirements, other options should be explored. In particular, internships in Japanese transplants in the United States can provide a high degree of exposure to Japanese management practices and may also establish contacts with Japanese managers that will continue to benefit the intern. Although it is unrealistic to expect such placements to provide the same degree of exposure to Japanese technology and management practices, the diversity of Japanese companies with U.S. operations can certainly provide insight into which practices are most readily transferable to the United States.

Finally, a formal debriefing process is needed for all interns regardless of the location or duration of the placement. Options could include periodic trip reports during the internship, a thesis due at the end of the internship describing lessons learned, group workshops for returning interns to compare experiences, and oral evaluations by faculty. The committee also suggests that the intern be required to give back something to their host companies, such as a research project done for them or feedback to the company managers suggesting ways to improve the firm.

SUMMARY

The committee has spent over a year visiting and talking to both faculty and students at the first eight programs funded by AFOSR. In reviewing their proposals and their program implementations to date, the committee has found that progress has been substantial. Each of the programs has added more students, created more internships, and expanded language training. Many have conducted useful, relevant research, and, in a few cases, books, software, and data bases have been produced or initiated. There is no doubt that the programs are adding value by exposing more engineers and managers to Japanese language and providing more internship opportunities.

Although the committee recognizes the funding constraints faced by the awardees when defining research projects, creating new courses, and coordinating educational efforts across academic departments, the committee believes that much more is possible and needed. Teaching engineers and managers Japanese language skills has value, but they must also be taught J/TIM practices.

As yet, little curriculum has been created to do this. Research in J/TIM is essential, but a broader span of industries and issues needs to be investigated, and results fed back into curriculum development. Although cultural aspects of the Japanese business system may be included in language courses, there is little evidence that the current programs funded by AFOSR are paying sufficient attention to the cultural aspects of J/TIM. If a strong national program in J/TIM is to emerge, complete with the creation of a viable academic specialization, the AFOSR program manager and the individual awardees, collectively, will need to address these issues.

3

Creating an Academic Specialization

Creating an academic specialization in J/TIM is more difficult than progress to date might indicate. Although each of the schools funded by the AFOSR has combined training in language and culture with management and technical coursework, most of the emphasis has been on providing language training to engineering and business students and on placing them in some form of internship in Japan. Research under the program has primarily augmented preexisting research efforts, and findings have yet to feed into curriculum development to any great extent. Although each school has made progress in implementing the steps described in their proposals, and arguably the early foundations of an academic specialization have been laid, a great deal of work is needed to realize the creation of such a specialization and the emergence of a strong national program in J/TIM.

Creating an academic specialization would provide much-needed focus for a wide range of activities, expertise, and resources now scattered among academic departments such as Asian Studies, Management, Engineering, and Humanities. Building a multidisciplinary J/TIM specialization would provide a coherent framework for research, curriculum development, faculty development, and continuing education and outreach activities. It would also provide a more formal structure for these multidisciplinary efforts, thereby helping to attract students and facilitating outreach to industry. The committee does not envision a degree-granting program, but some form of certification to recognize students who complete J/TIM training is desirable. Several of the current programs already offer such certificates at both the undergraduate and graduate levels.

Creating an academic specialization in J/TIM will be difficult and time-consuming. Making the effort, however, is the best means to ensure that J/TIM becomes the multidisciplinary course of study that the subject matter requires.

Much of the difficulty in creating a new academic specialization stems from the academic culture in U.S. universities. In each of the schools funded by AFOSR, more attention is needed to address the impact that this program will have on the university structure and infrastructure and on the faculty that will participate the J/TIM program. There are three primary areas of concern here: curriculum development, faculty development, and university organization.

CURRICULUM DEVELOPMENT

A fundamental prerequisite of a multidisciplinary area of academic specialization such as J/TIM is a coherent curriculum. Such a curriculum would be open to engineering and business graduate and undergraduate students, resulting in a certificate of specialization or even a major degree in J/TIM. Course development may take some time, since much of it will depend on the research results produced by the overall program, not just each school individually. Even so, planning for the needed comprehensive curriculum should start now.

The curriculum should contain the fundamental, core body of knowledge that the graduating student is expected to know, and which will differentiate the J/TIM student from the more traditional graduates in business and engineering. Examples of specifics that would be expected in such a curriculum would be technology management courses that expose students to Japanese accounting practices, research practices, personnel practices, university-government-industry relationships, contractual and legal practices (e.g., positions on intellectual property rights), and shop floor management practices, all presented with necessary and appropriate contrasts to the corresponding U.S. practices. Frequent use of case studies might be expected in the curricula developed by many of the universities, and the inclusion of reading lists and other reference materials would be essential. Although each university would emphasize its particular strengths, technical capabilities, and industry foci to tailor its curriculum to a certain extent, a core of essential information should be included in every program's curriculum.

Other courses, developed in conjunction with faculty in the humanities, would include language training in technical Japanese and exposure to a broad cross-section of Japanese culture and social practices. Specific curricular considerations would be given to preparation for internships and other Japanese "practica" and to the off-campus outreach activities to industry and government laboratories.

FACULTY DEVELOPMENT

There are two aspects to the development and growth of J/TIM faculty. First, the development of a new academic area in Japanese technology management requires the concomitant development of a new expertise among the faculty, particularly in terms of the cross-linkages between business, engineering, and the liberal arts that this program envisions. The faculty is expected to do research in J/TIM, and publish that research in appropriate archival journals. In some cases, however, the "appropriate archival journal" might not be obvious because of the novelty and interdisciplinarity of the research. It is essential, therefore, that special attention be given to ensure publication of research into technology management issues.

Second, it is also essential that university administrators recognize these difficulties in characterizing their faculty, particularly in the context of merits, promotions, and tenure. Successful program faculty probably cannot be placed in the standard pigeon holes of electrical engineering, computer science, business, law, linguistics, history, etc., all of which might be found in the program. Furthermore, it is likely that successful program faculty will

publish articles that are multiply authored, with other authors coming from other fields (hence other departments). This can lead to serious administrative difficulties in evaluating performance, both from the point of view of the quality of the work done, and the identity and background of the evaluators themselves. Typically, academic personnel committees and administrators have little patience with the difficult job of sorting out who did what, and assigning appropriate credit, yet this is essential if J/TIM programs are to gain academic credibility in the university community. This is a well-known problem in other multidisciplinary centers, such as the engineering research centers and science and technology centers funded by the National Science Foundation, but it has been dealt with effectively in most of those centers.

Attention needs to be paid to both of these issues by the university faculty from the very beginning of their activities, or in the case of potential new programs, at the preproposal stage. Otherwise, the programs will likely be only tangential to the universities' core activities in engineering and business.

UNIVERSITY ORGANIZATIONAL ISSUES

A number of organizational issues need to be addressed by the universities funded to develop J/TIM programs. Some of these have been discussed above, such as the thorny problem of merits and promotion of faculty engaged in interdisciplinary activities. Other issues include the following:

- *Lines of communication and responsibility.* To whom does the program director report? If it is a dean or department head, the program is embedded in, or formally located in, one of the colleges or departments. This might hinder the development of the desired multidisciplinary nature of the center. Various alternatives have been developed for other multidisciplinary programs, which should be examined for their applicability to J/TIM programs.

- *Existence of suitable infrastructure.* Are the location and amount of administrative space for the program, which houses its faculty director, administrative officer, receptionist, clerk, bookkeeper, etc., satisfactory for its operation? These questions again raise issues concerning university administrative authority over the program.

- *Student recruitment.* How and where does the program recruit its students? Are there unresolved issues regarding funding of these students, payment of indirect costs, etc.?

- *Program elements.* Does the existence of program elements such as internships and off-campus outreach cause conflict with existing university education abroad or extension services?

- *Academic specialization.* Are there serious university obstacles to the development of a new area of academic inquiry, and more specifically, to the generation of approval for certificate or degree-emphasis programs?

SUMMARY

Integrating multidisciplinary approaches into a coherent program of Japanese industry and technology management training is a major challenge, particularly since it is a field that is under development. Faculty from various departments and other programs must be brought together, and a diverse body of student participants recruited, including undergraduate and graduate students, post doctoral research fellows (who may be recruited specifically to the program) practicing science and engineering, and business professionals who need university extension-type courses. New curricula must be generated, tailored to the needs of both faculty and a diverse group of students. And all the challenges of fitting such a program into the typical university structure must be faced.

These challenges, generally related to how any new academic initiative gets implemented in universities, have not been faced in the J/TIM programs of the schools funded to date.¹ As noted in Chapter 2, curriculum development so far has been spotty, and only a few of the schools offer a certificate or concentration in J/TIM as part of an engineering or business master's degree. If a viable academic specialization is to emerge from the AFOSR programs, curriculum and faculty development and organizational issues of how J/TIM fits in the university structure must be addressed directly. Otherwise, these programs are likely to continue to be primarily Japanese language training for engineering and management students and intern placement activities, an outcome that falls short of the objectives of the Congress in creating the program.

¹It is worth noting that Berkeley has been struggling with many of these issues in its efforts to create a strong Management of Technology Program. MOT is also a multidisciplinary field, with elements of engineering and management but requiring strong synthesis of the two. It, therefore, does not fit neatly into the typical university structure.

Outreach to Industry

In addition to strengthening the academic specialization of J/TIM, the committee sees as a major objective of the AFOSR program the strengthening of the U.S. industrial manufacturing and research base through improved understanding of Japanese industry and technology management and the cultural context in which it is applied. Achieving this objective can be best accomplished through aggressive outreach to industry and government laboratories to determine what the expectations of these customers are and how best to meet them. To their credit, many of the programs have actively sought input from the local industrial and technical communities regarding development of their programs. All of the programs have organized conferences, workshops, and other meetings of interested parties from industry; all provide evening and part-time courses and seminars that are convenient for midcareer students; and several have been broadcasting courses and seminars over various networks, with NTU the most extensive. In addition, many of the programs have contacted relevant government laboratories to provide them with information about program offerings or to tailor special courses or seminars to the interests of laboratory researchers. Although these efforts have met with varied success in terms of participation, these mechanisms deserve emphasis as practical ways to meet the needs of midcareer professionals, as reflected in Table 2-1.

Despite the efforts to create and market activities that can reach industrial participants, many of the programs have found the level of industry interest to be disappointing. Much of the corporate United States does not see an urgent need to have J/TIM expertise resident in the corporation and often does not take advantage of it by employing engineers and managers with Japanese experience or expertise in Japan-related activities. The full value in having a strong understanding of J/TIM—from insights into the structure and processes of Japanese organizations to timely knowledge of Japanese technological and scientific developments—is not generally recognized by many U.S. firms. An additional task for the J/TIM programs, therefore, is to build a convincing case of this value—to help companies understand the long-term returns from J/TIM investments—and to market this case aggressively.

Generating change in industry, both to support research and training in J/TIM and to change management practices as a result, is another major challenge to the programs funded by AFOSR. Generally speaking, that change begins to happen in earnest for a company when the top management becomes determined to change. Without that determination, educating and training those in the middle and lower ranks will likely be a frustrating exercise for both the trainers and the trainees who are willing and eager to learn. A graduating engineer or scientist who understands Japanese management methods and starts his or her career in a company that has not yet become determined to change will most

likely become frustrated and move on, or adopt existing practices and eventually forget the things learned previously. Seeding a company with entry-level engineers, scientists, and managers with training in J/TIM and waiting for them to move into high enough levels and positions throughout the company that they can lead in the change will be a very long process.

Once the company's top management becomes determined to change, it will be important for others in the organization to become knowledgeable about Japanese management practices and to become capable of dealing with and learning from their counterparts in Japan, whether for the purpose of acquiring additional insight on management techniques in general, applying those techniques to their company's processes, or gaining technical knowledge relative to their processes and products. For a company of any size, there will be many employees at many levels of the company, from top and middle management to technical scientists and engineers, who will need to understand Japanese management practices. To foster understanding, many of these individuals could profit from direct contact with their Japanese counterparts. There will also be many others in the company who may not directly interface with the Japanese but could make valuable use of access to Japanese technical information for the purpose of keeping abreast of technical developments there—which is the other objective of the legislation. Once the value of J/TIM knowledge is recognized by top management and others in a company's hierarchy, support for the J/TIM programs from industry, including participation by experienced engineers and scientists, should grow.

Helping companies get to this point is the difficult marketing task of the J/TIM programs. One approach, at least initially, may be to target specific firms that have shown interest in improving their management practices and learning more about Japan. Many of the programs already have a short list of companies interested in the program who may cosponsor it, such as the sponsors of the MIT Japan Program, or serve on an advisory board, such as at Berkeley. J/TIM programs may also be able to link more closely with other programs at the university geared to industry outreach. For instance, closer links between the MIT Japan Program and its Leaders for Manufacturing program might be beneficial to both programs. By targeting their outreach efforts at the top and middle level of interested companies, the programs will raise awareness of their activities and capabilities in the broader industrial community; acquire a stronger sense of what the market demands from an audience who is interested; and succeed in adapting research, courses, and dissemination mechanisms in a way that will generate continued industry interest from a broader base of companies.

Another approach to generate specific company interest is for individual programs to target specific industries and to market the results to companies in those industries. As was pointed out in Chapter 2, the AFOSR should strive to have a greater variety of industries addressed by its funded universities. The current focus on electronics, computers, and automobiles is understandable given the location of the awardees. Expanding the list to include industries such as aerospace, biotechnology, manufacturing process equipment, and others would not only enhance the coverage of Japanese technological developments but also provide a strong basis for greater industry involvement in the programs. The objective would be to create an awareness of the competitive position of the U.S. industry and of

companies in the industry, vis-a-vis Japan. A good example of a university being involved with an industry over a period of time and helping it to understand its true competitive position is the long-term work of the University of Michigan with the auto industry. This approach to the J/TIM programs would also provide a much stronger basis for cooperation among the different schools, reduce research redundancy, and provide a broader constituency for marketing and dissemination of results.

Another approach to marketing that these programs should not overlook is contact with the human resource managers in industrial companies, instead of company chairmen or research and development directors. Human resource managers are senior vice presidents in many companies, in a strong position to identify the kinds of skills the company needs and to help program directors tailor their efforts to fill those needs. Maintaining close contact with human resource managers also helps to provide a mechanism to assist program graduates with effective placements in industry.

To help bring the resources and capabilities of J/TIM programs to the attention of smaller companies, the programs should make themselves known to federal and state industrial assistance programs, such as the manufacturing technology centers sponsored by the National Institute of Standards and Technology. The staff of these programs should be invited to participate in J/TIM programs so they can pass their knowledge on to their clients in industry. They can also inform smaller firms of the J/TIM programs, so those firms would be more likely to participate directly.

Finally, in addition to industrial firms and government laboratories, another market that the programs should not overlook is that of lawyers, financiers, government policy makers, and others who work closely with the Japanese but in service areas indirectly linked to industrial activities. These lawmakers and service providers negotiate with their Japanese counterparts in a wide range of contexts and need a better understanding of government-business relations, legal practices, regulation, capital markets, and other aspects of the Japanese business system. Research, courses, conferences, and seminars that address the needs of these individuals are also important.

Many universities have developed effective programs for the continuing education of those already in the work force. These programs often have names such as "University Extension" or "University Continuing Education," are administered by separate college deans or directors, and are usually apart from the mainstream of the other educational elements of the campus. In the case of J/TIM, such an off-campus outreach effort is *central* to the program, because it is scientists, engineers, and managers in industry and the national laboratories who have the most to gain from this program and who are the primary targets of the supporting legislation.

Perhaps the most critical uncertainty relating to this program concerns the utilization by U.S. industry of the talented people produced by these programs. The overarching goal of the program is to learn from Japanese practices how to improve U.S. technology and industry management. Therefore, the lessons must be useful to and applied by U.S. industry if they are to have direct impact. Critical questions are whether U.S. industry is really interested in Japanese science and technology information, whether and how U.S. researchers can observe good management of technology practices in Japan and learn from them by adapting the lessons to the U.S. context, and whether U.S. industry values the skills

of the "Japan ready" engineers and managers who are nurtured by these programs. The only way for the programs to answer these questions is through a continuing dialogue with industry and national laboratories—the primary "customers" of the programs—to ascertain their needs and priorities and to work with them to develop career tracks for individuals.

Intraprogram Coordination

To institutionalize a national program of U.S.-Japan industry and technology management training will require effective coordination and dissemination across the individual university programs. The need for coordination applies to nearly every aspect of the grant programs—coordination among the university programs, developing effective interplay among the various departments or elements of each program, coordination between the programs and other programs with similar objectives, and ensuring a fit between the legislation that created the programs and the long-term needs of the country. Dissemination involves getting the knowledge or the trained people to where they are needed for the purpose of achieving the objectives of the legislation. In view of the limitations on resources, coordination and dissemination efforts are essential to avoid unnecessary duplication of effort, to create synergies and shared resources, and to establish a long-term national effort.

The committee can envision a variety of approaches to strengthen the level of coordination and cooperation across the individual university programs and thereby enhance the effectiveness and accomplishments of the overall program. Some of these approaches, such as greater coordination of intern placements and coordination of more-diverse research efforts, have already been mentioned. These are short-term issues that could strengthen the program as it exists now. Another, longer-term opportunity that should be explored is creating a strong network to share intellectual resources, for instance by emphasizing telecasts of seminars and special lectures to all the programs and to other industry and university locations. The NTU already does this, as do some of the other programs. The following section describes possible networking approaches that the AFOSR and the individual programs should consider in their future plans.

SHORT-TERM COORDINATION ISSUES

In addition to the coordination of intern placements and general outreach in Japan, there is an obvious need to strengthen coordination in the United States among the programs. Each university program offers a different set of elements relevant to the overall goals of the legislation that established the national program. Considerable overlap of expertise may exist; complementarity can be enhanced through better coordination and sharing of resources. Opportunities to expand the range of research activities to cover a

broader set of industries have already been discussed. Other ways to build coordination may include activities such as joint planning of seminars, study missions to Japan, and curricula design, as well as joint dissemination activities for a particular audience such as the Washington policy community. To achieve maximum impact, efficient dissemination of program results, including debriefings of participants who have spent time in Japan and distribution of reports, is essential; coordinating this dissemination across all the funded programs needs more attention. In a very real sense, the development of J/TIM as a field depends on deepened interaction among researchers who can build on each other's work and share work in progress.

Another area in which broad coordination is desirable is in setting standards for the level of expertise expected of different types of participants in the program. Two issues have already been addressed: implementing some type of standard examination for language proficiency examination and developing a set of core courses for the J/TIM curriculum. Curriculum development also needs to include appropriate cultural instruction, in a context that relates to both specific J/TIM practices and knowledge of the total Japanese business system as described in Chapter 1. The committee is not recommending a rigid approach to curriculum standards, but the program directors and involved faculty should jointly develop a set of expectations of what program participants should know and how they should learn it.

Other areas in which coordination should be strengthened might rely more on computer-based networking and teleconferencing. Language training and J/TIM courses could be shared to take advantage of particular strengths at different universities and to implement a core J/TIM curriculum more rapidly. Data bases of current and proposed research projects and research results could be maintained across the system, helping to minimize research duplication and facilitating cross-industry comparisons of findings. A similar effort could be instituted to track internships and document intern experiences, to facilitate career-long networking of program participants, and to maintain a central electronic file of faculty site-visit trip reports. The MIT Japan Program is developing three data bases using AFOSR funds, a "Japan-Aware Professional Data Base," a "Japan Science and Technology Experts Data Base," and a "Japan Trip Report Data Base"; these efforts could be expanded, new data bases created, and the information shared across all of the programs.

LONG-TERM NETWORK OPPORTUNITIES

With rapid improvements in computer-based networks and teleconferencing technologies, the committee can envision a system of AFOSR-funded centers that share resources and experiences not only with each other but with other schools that have expertise to contribute. Once the funded universities were linked in a way that shared information and intellectual resources—lectures, courses, and teaching modules, for instance—new opportunities to pull in other resources and students could be explored. One approach might be to build on the experience of the University of Wisconsin/EAGLE/NTU program to use video technology to reach a large audience around the country. NTU could provide the infrastructure for pursuing this distance learning approach, and each of the individual

programs could provide the course content. If integrated with a local program of instruction, this type of approach can provide quality instruction modules. A major challenge for this network approach, however, is the establishment of some interaction among the students and faculty and the improvement of coherence in curricula. Creative techniques are now being used in Japanese language training to enhance student-faculty interaction and communication. One way in which network programs have attempted to enhance interaction is by organizing short-term study missions to Japan. Another mechanism for enhancing interaction is internships in Japan supervised by faculty.

Another approach might be to pool the resources of an entire university system to provide more-effective instruction than any single school could offer independently. One campus may have an excellent language training program, while another has premier faculty research in an area such as Japanese manufacturing management. By drawing these resources into the overall network, great strides could be made in establishing a national J/TIM program. In particular, if students can receive credit for instruction at other universities in the system and if there is a central coordination point shared by all of the universities, this broader network could yield wide synergies. One advantage might be in outreach efforts, because the industry contacts and interaction maintained by different university campuses would be drawn into the network, thereby helping marketing efforts, industry access, and dissemination.

Yet, another approach to building input and access to a national J/TIM system would share J/TIM resources with a greater number of organizations. Rather than limiting participation to the students of a particular university, of a university system, or of universities in the network, this approach would be designed to provide opportunities for unaffiliated students and organizations to participate. The shared approach would, in theory, overcome the insular tendencies of universities, for instance in recruiting participants, and would help to link the AFOSR program with other emerging efforts to support U.S. industry. A goal might be, for example, to recruit participants from polytechnic colleges, women's colleges, and historically black colleges and universities. Another goal might be to raise participation of smaller companies dramatically. Ongoing liaisons and collaborations with such institutions would deepen and strengthen the J/TIM program by including students and companies who normally would not have access to such resources but who, arguably, are best placed to implement the J/TIM practices. This shared approach could also provide a mechanism to link the J/TIM program with various federal and state industrial extension programs, such as the manufacturing technology centers.

SUMMARY

The creation of a new program, particularly one as complex and ambitious as the U.S.-Japan Industry and Technology Management Training Program, presents tremendous challenges but also marvelous opportunities. The universities funded by AFOSR bring individual strengths that all contribute to the national goal of strengthening U.S. understanding of Japanese technology management practices and technology developments. Explicit efforts to combine and coordinate these individual strengths could dramatically raise

the impact and value of the total program. Coordination would expand the breadth of research being conducted in Japan, speed the dissemination of research results, broaden the audience, make the placement of interns in Japan more effective and valuable, and enhance the visibility and credibility of the total program in the eyes of its customers in industry, government laboratories, and even academia.

Though some coordination among the programs has taken place, the long-term advantages of a well-coordinated national program have yet to be realized. The committee recognizes how difficult it will be to achieve the broad-based, strong coordination needed to fulfill the program's promise. Rivalries among universities, traditional academic independence in both research and instruction, and concerns about financial commitments will all pose barriers for creating a national J/TIM system. Certainly some of the more mechanical areas of coordination, such as joint conference sponsorship and perhaps even intern placement, will be relatively easy to achieve. The more visionary aspects, however, such as computer networking, teleconferencing, course sharing, and broad inclusion of a variety of academic and nonacademic organizations, will require both strong central leadership from AFOSR and patience. The first steps will be to generate discussion among the program directors and begin to identify mechanisms to achieve the needed coordination. The committee hopes that this report will foster those first steps.

Conclusions and Recommendations

The U.S.-Japan Industry and Technology Management Training Program is now over three years old. Three sets of proposals have been submitted, and first-round awardees (except Vanderbilt) have received additional funding beyond the initial two-year awards. After spending more than a year reviewing the first eight awardees, the Committee to Assess U.S.-Japan Industry and Technology Management Training Program is generally impressed with the effort each awardee has put into fulfilling the tasks described in their proposals. Language training has been augmented, a few new courses have been developed and more are planned, and research efforts seem to be proceeding well. The greatest accomplishments to date are that more engineering and management students are learning the Japanese language; a greater number of interns are being placed in Japanese industry and laboratories; and a growing number of seminars, conferences, and other outreach mechanisms are being used to educate U.S. managers about Japanese technology and management practices.

However, the committee could also take a less optimistic view of the results of the program to date. Research efforts have ignored several aspects of J/TIM that the committee perceives as important; there is substantial overlap in the industries receiving research attention; and relatively few research projects appear to have been created as a direct result of AFOSR funding. Because few new courses have been developed, a core curriculum in J/TIM has yet to emerge. The training being provided, therefore, is almost exclusively language training. Although language training is a critical part of the skills this program should provide, there is much more to J/TIM that should be conveyed to students. The language training often serves mainly to prepare students for internships, and most of these programs have placed a great deal of emphasis on internships as the primary mechanism for educating students in J/TIM practices and culture. Although placing engineering and management students in Japanese internships does provide valuable experience, this approach to the training aspects of the program does not ensure that real understanding of J/TIM practices is gained, and it limits the number of students acquiring valuable J/TIM skills.

Much more can be, and needs to be, accomplished by this AFOSR program. The committee recognizes, and has tried to convey, the difficulties that arise in efforts to create a new academic specialization, as J/TIM could become; the problems in achieving effective coordination across academic institutions; and the fundamental problems of marketing the benefits of studying and teaching J/TIM to a U.S. industry that remains largely indifferent.

None of these problems is easy to overcome, particularly given the limited resources for the program provided by the Congress. With a clear vision of what can be accomplished, however, and appropriate adjustments to the management of the program, this committee believes the program can be much stronger in the future.

PROGRAM EXPECTATIONS

The previous chapters have described appropriate expectations for the total AFOSR program. These expectations are summarized here for each of the program elements:

Research. First, research funded under this program should focus on Japanese management of technology, including its cultural context as it varies across industries and companies. Second, greater coordination across the funded schools would help to minimize duplication. Third, a greater diversity of Japanese industries should receive research attention; the committee has suggested aerospace, machine tools and other manufacturing process equipment, advanced materials, and biotechnology, in addition to the areas of electronics, computers, and automobiles that are being addressed now. Explicit discussion among the current program directors could prioritize this list and begin to identify specific research projects. Fourth, the experience of Japanese-managed operations in this and other countries, in many different industries, should be examined more closely.

The goal of these efforts is to diversify research in order to strengthen U.S. understanding of Japanese technology management practices and to broaden the relevance of the total J/TIM program. The AFOSR should make use of its funds for research conditional on more diverse coverage of industries. This condition should be made clear in future requests for proposals. Achieving this diversity in research projects could be spurred by placing greater emphasis on research sponsored by industry or government laboratories.

Curriculum. A consistent, well-defined curriculum in J/TIM and Japanese culture should be a key characteristic of every program funded by the AFOSR. Such a curriculum would not require many courses—probably less than ten. Some minimum number of core courses should also be defined. The content of these courses should be tailored for application in both for-credit courses and continuing education courses for midcareer professionals. Discussion among the program directors and participating faculty should be required in order to define the content of this curriculum and to develop a plan to cooperate on its development and implementation.

Language training. Given the emphasis each program has placed on language training, this is the strongest aspect of the program to date. Nonetheless, there is a need to develop explicit language proficiency expectations for different types of students and standard tests for the overall program. In particular, potential interns should be required to meet rigorous general and technical language proficiencies. Again, consensus among the program directors is the way to develop the needed standards.

Internships. Effective intern placements require significant advanced planning in Japan and rigorous preparation by the interns. Placements should be well matched to the interns' technical expertise. To improve the availability of intern placements and the effectiveness

of the resources being used to find those placements, a central coordinator should be established in Japan. This coordinator role could be played by one of the offices maintained in Tokyo by some of the funded schools, MIT or Stanford for example, or it could be run and staffed directly by the AFOSR, or some other arrangement may be possible. Alternatives to internships in Japan, such as in Japanese plants in the United States or elsewhere, should also be explored. Interns should be required to submit periodic progress reports and to write reports when the internship is finished, including lessons learned and technology assessments. They should also prepare a report or perform some type of project for the sponsoring firm. Finally, every effort should be made to link interns to commercial sponsors in U.S. industry who will expose the student to domestic management practices and provide practical technical benchmarks prior to the internship in Japan.

Outreach. The programs should develop strong ties to industry, both locally and nationally. Efforts to diversify research should generate broader industry interest, but aggressive marketing efforts should also be put in place. Courses, seminars, lectures, and other media should be made available at times and in ways convenient to midcareer professionals. Outreach efforts should extend beyond the large companies most likely to provide financial support to include small and medium-sized firms who might benefit the most from the training provided by the programs. Efforts should be made to include staff from manufacturing technology centers and other manufacturing extension services, so they can pass their knowledge on to their clients in industry.

Fulfilling these expectations for the overall AFOSR program will require much more cooperation and coordination among the individual programs. The committee envisions the individual programs coming together as parts of a strong national program, rather than remaining the self-contained efforts that they are now, for the most part. Coordinated, joint efforts for industry outreach and targeted marketing of conferences and seminars would supplement their individual efforts. Curriculum development could be accelerated by greater sharing of course material and instruction. Cooperation on research would maximize the industries and subjects that could be covered. Sharing the results would speed dissemination and generate greater industry interest.

FUTURE PROGRAM MANAGEMENT ISSUES

Achieving the level of coordination needed to create a strong national J/TIM program has implications for future management of the program by AFOSR.

Sustained Funding

The most prominent issue is the question of sustained funding. The pattern established by the AFOSR so far is to request proposals every year and award two-year grants to the winners. Past awardees are encouraged to submit new proposals, but additional funding has been based on the new proposal, not past performance. Although there has been no assurance of sustained support, three of the first four awardees did receive new funding in

the third-year grants. This approach to funding makes long-term planning by the winners very difficult, since additional funding is not assured, and it minimizes incentives to cooperate with other awardees. It also provides no basis for the AFOSR to award good performance or to penalize poor performance.

The committee believes that greater assurance of sustained funding would be beneficial to the overall program. Few (maybe only MIT) of the awardees are in a position to be self-supporting. Therefore, a lack of continued funding from AFOSR risks losing the investments made to start the programs in the first place. Increasing the period of assured funding from two years to five years would provide awardees with the confidence to make the effort needed to establish curricula, generate student interest, market the program to industry, and overcome many of the institutional barriers to creating an academic specialization that are described in Chapter 4. It would also provide the AFOSR with greater leverage in achieving its goals for the overall program.

Such an approach to funding has its disadvantages. Sustained funding of existing programs implies that no new programs will be funded or that funding levels will be reduced to reserve some percentage of funds for new awardees. The objectives of the overall program would be served better by funding existing programs to the fullest extent possible during start-up, when costs are high, and until alternative funding sources are secured. Once programs are financially stable, AFOSR funding to them would be reduced and could be channelled to new awardees.

Performance Criteria

Sustained funding must be conditional. Performance criteria should be defined and met in order to qualify for continued funding throughout the proposed five-year period. Examples of possible criteria include the following:

- *Growing level of industrial support.* A plan, including a schedule, to become self-sustaining should be part of the proposal process. General sponsorship of the program, fee income from conferences and other events, fee income from students, and industrial support through sponsored research should all be expected. If after three years industrial interest remains weak, the AFOSR should phase out funding over years four and five.
- *Effective, aggressive outreach efforts.* In addition to raising financial support from industry, the programs should exhibit close ties with local government laboratories and military facilities. Diversity in industrial contacts should also be a goal, so that the program benefits more than the largest U.S. corporations, who are more likely to send managers for J/TIM training and to support the programs financially. Creation of industrial advisory boards should also be considered.
- *The general strength of the program as measured by enrollments, effectiveness of language training, number and diversity of intern placements (including to transplants), and implementation of appropriate courses in J/TIM and culture.* Evidence that a true J/TIM training program is being implemented, not just expanded language or research efforts, should be expected.

- *Willingness to cooperate with other awardees and to contribute to the goals of the total national program.* This would likely require modifying research agendas, sharing course material, cooperating on intern placements, and jointly preparing conferences.

These kinds of performance criteria are the best measures of the benefits and effectiveness of a program such as this. Because of different initial circumstances, numerical comparisons among the awardees for objectives such as enrollments or research papers would be unfair; the AFOSR program manager would need to exert his or her judgment, perhaps with input from the programs' industrial customers or some similar source.

Implementing use of these performance criteria should be planned carefully. Because these were not included in the requests for proposals to which the current awardees responded, it would be inappropriate to expect them to meet objectives for which they are unprepared. Instead, these performance criteria should be included in any future requests for proposals. Current awardees would be expected to submit proposals based on these new criteria if they desire continued AFOSR support.

Central Coordination

To achieve the needed level of coordination across all of the awardees, the AFOSR should consider reserving some small portion of the annual program budget for coordination activities. The central intern placement office in Japan, if implemented, would be an example. Another possibility the committee has discussed is to fund a program coordinator. This is not a role the AFOSR program manager could play for several reasons: program managers tend to change frequently—the J/TIM program has already had three; the J/TIM program is one of several for which the program manager is responsible, so the time to be an effective coordinator is not likely to be available; and an effective coordinator would need greater understanding of academic culture and rivalries than the AFOSR program manager is likely to have. Therefore, there may be benefits gained from appointing a program coordinator from the academic community. Perhaps each of the university program directors could fill this role on a rotating basis, but a permanent coordinator for the total program would probably be more effective. This coordinator would be responsible for facilitating regular meetings of program directors and faculty, identifying and managing activities sponsored jointly by multiple participating program, and developing an identity for the national program beyond that of the individual awardees. Although such a national program coordinator would be a boon to the overall program, the committee recognizes the difficulties of employing such a manager, especially in terms of cost. Therefore, the mechanics of implementation should be discussed thoroughly, and alternatives, such as rotating this responsibility among program directors, considered.

FUTURE PROGRAM FUNDING

Congress created the AFOSR program in 1991 with \$10 million and continued this level of funding for 1992 and 1993. Unfortunately, there has not been any assurance in any year that the program would continue to be funded or at what level it would be funded. Fiscal year 1994 funding has been cut to \$5 million.

This funding uncertainty has virtually forced the approach to proposal requests and awards that was adopted by the AFOSR. Two-year awards are all the AFOSR has felt confident enough to give. In turn, the uncertainty of continued funding has limited the planning horizon of each awardee to little more than two years. Proceeding into the future so gingerly is no way to generate and sustain the strong national program that is needed, and which this funding could provide.

It is very difficult for the committee to judge how much funding is necessary to create the viable national system of J/TIM research and education envisioned by the committee. Given the jumble of existing resources used to create awardees' J/TIM programs, neither how much AFOSR funding is necessary nor the constraints that will be imposed by reduced funding are clear. However, it seems safe to assume that with nine awardees currently being funded, an annual budget of \$5 million is probably insufficient to sustain all of them, let alone create more. That amount would result in grants of slightly more than \$500,000 per awardee to pay for some faculty salaries, institutional overhead, and student support. One program director has estimated that these and other program costs amount to \$40–45,000 per student, so \$500,000 will support very few students. The likely result of the reduction in the federal appropriation is that it will force the AFOSR to cut the number of programs funded and will increase the pressure on awardees to raise funds from other sources. It also increases the importance of cooperation among programs to minimize redundancy and to realize the greatest value from the available resources.

CONCLUSION

The committee has outlined an ambitious plan for the future of the AFOSR's U.S.-Japan Industry and Technology Management Training Program. Obstacles to fulfilling these ambitions are many, ranging from industry indifference to rigid academic organizations and inadequate resources. The committee is convinced that these obstacles can be overcome, but doing so will require stronger funding commitment from the Congress, appropriate incentives from the AFOSR, well-defined performance criteria, and clear expectations of what the funded universities should achieve and how the total program will operate. The potential benefits to U.S. industry are certainly worth the effort.

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Appendix A: Pertinent Text of the 1991 National Defense Authorization Act

National Defense Authorization Act for Fiscal Year 1991; Report 101-384; July 20, 1990; pages 121 and 122.

U.S.-JAPAN INDUSTRY AND TECHNOLOGY MANAGEMENT TRAINING

The committee [Senate Armed Services Committee] believes that the strength of the U.S. defense industrial base directly depends on the strength of the Nation's overall industrial base. One U.S. ally, Japan, has demonstrated outstanding abilities in building and sustaining a strong industrial base achieved in large part by creatively using science and technology to support its industrial base activities. The committee believes that the United States can significantly benefit by understanding, in detail, the management and business practices used by Japan in these areas of science, engineering, and manufacturing.

The committee directs the Secretary of Defense to establish a program which will support, through competitively awarded grants, at least 10 U.S. universities, colleges, or nonprofit institutions to study Japanese industry and technology management methods. A major purpose of these programs shall be to prepare scientists, engineers, and managers to learn from their Japanese counterparts by being able to work closely with them throughout their careers in government or industry. The committee believes that to accomplish this required close working relationship, the programs should provide training in the Japanese language and an understanding of Japanese business and social culture. Although this program is not intended to provide direct grants or aid to individuals, the program should provide its participants with an opportunity to be directly involved in Japanese scientific research, engineering development, and management programs and should be structured to help keep American government and industry abreast of Japanese scientific and technical developments and their importance.

In selecting the programs to support under this initiative, the committee directs the Secretary to give special consideration to the inclusion of universities, colleges, and nonprofit institutions that can support participation of scientists, engineers, and managers from DoD and DoE laboratories. Special consideration should also be given to selecting organizations that agree to share program costs on an equitable basis, and which have demonstrated an ability to promote interchange of Japanese and U.S. scientists, engineers, and managers, including placing U.S. participants in Japanese research facilities and laboratories.

Appendix B: AFOSR Program Announcement

Selections from the *Announcement for the Department of Defense United States-Japan Industry and Technology Management Training*. Air Force Office of Scientific Research Special Announcement

I. OBJECTIVES

The Air Force Office of Scientific Research (AFOSR) announces a Fiscal Year 1993 competition to support the United States-Japan Industry and Technology Management Training Program for the Department of Defense (DoD).

The strength of the U.S. defense industrial base directly depends on the strength of our nation's overall industrial base. In light of Japan's technological successes, there is merit in understanding, in detail, the management and business practices used by Japan in the areas of science, engineering, and manufacturing. An increased understanding of Japan's technology management methods, and training in the Japanese language and culture will benefit American scientists, engineers, and managers in establishing long term relationships with Japan. This research, education, and training should serve to create a growing cadre of US researchers and technologists in industry, government, and academia that can stay abreast of Japanese scientific and technical developments and their importance.

The goals of the program are as follows:

- a. Increase understanding of Japanese industry and technology management methods for the creative use of science and technology.
- b. Provide U.S. citizen and permanent resident scientists, engineers, managers, and students of these areas, training in the Japanese language and an understanding of Japanese business and social culture.
- c. Provide program participants with opportunities to be directly involved in Japanese scientific research, engineering development, and management activities.
- d. Provide mechanisms for participation of scientists, engineers, and managers from the Department of Defense and Department of Energy laboratories.
- e. Create mechanisms for cooperation and partnership between US industry, academia, and government to apply and employ the results of this program.

AFOSR implemented this program for DoD in 1991. In response to the 1991 announcement AFOSR awarded four two-year grants to: Massachusetts Institute of Technology; University of Michigan; University of Wisconsin-Madison on behalf of the Engineering Alliance for Global Education (EAGLE), a consortium of 13 engineering schools, and the National Technological University (NTU); and Vanderbilt University.

In 1992, four two-year awards were made to Stanford University, University of California-Berkeley, University of New Mexico and University of Texas-Austin (joint award), and University of Pittsburgh and Carnegie Mellon University (joint award).

AFOSR is now seeking proposals from institutions of higher education and non-profit institutions for 1993 awards. These institutions must demonstrate records of high accomplishment in the disciplines of science, engineering, and business management. Institutions submitting proposals for participation in the US-Japan Industry and Technology Management Training Program will be expected to present evidence of understanding of the complex subject matter, including the interfaces among Japanese science, technology, business management and culture.

Special consideration will be given to selecting organizations that agree to share program costs on an equitable basis, and which have demonstrated an ability to promote interchange of Japanese and U.S. scientists, engineers, and managers, including placing U.S. participants in Japanese research facilities and laboratories. Proposing institutions are expected to have established relationships with Japan's academic and R&D communities.

The four primary 1991 awardees are eligible to compete for the 1993 awards; the proposals from these awardees, if they resubmit, should demonstrate progress in obtaining other sources of support. Since cost sharing, outside support, and plans for outyear support were important considerations for selection in 1991 and continue to be important considerations for 1993, the 1991 grantees are eligible for awards that should not exceed two thirds of the amount awarded to them in 1991.

The 1992 awardees are not eligible to submit proposals for the 1993 awards.

AFOSR, on behalf of DoD, plans to award several two-year grants of approximately \$1 to \$3 million in magnitude. Awards will be made to as many institutions as possible.

Institutions receiving grants will be expected to work cooperatively with the new and 1992 grantees to meet the overall program goals. Cooperation and sharing of ideas among the grantees are critical to the overall success of this program.

The AFOSR technical point of contact for this competition is Lieutenant Colonel Claude Cavender, AFOSR/NI, 110 Duncan Avenue, Suite B115, Bolling Air Force Base, Washington, D.C. 20332-0001, phone (202) 767-4970.

Appendix C: Cultural Relativity and the Study of Japanese Management

W. Mark Fruin

INTRODUCTION

Major Western studies of Japanese firms and industries are inevitably linked to the frames of reference with which America and American-trained scholars have looked at Japan. Beginning with Ruth Benedict's *The Chrysanthemum and the Sword* (Benedict, 1946), the first social scientific investigation of Japanese society by an American scholar, studies of Japan should be understood in terms of what was happening in America as much as what was happening in Japan. Ruth Benedict's pioneering work, for example, fixated on what were seen as apparently incongruous cultural elements, such as *giri* and *ninjo* (duty and feeling), *seppuku* and *kyoshi* (ritual suicide). Yet much of the incongruity for Benedict was related to the Pacific War and to America's struggles with a little-understood enemy, Japan. Indeed, the title of Benedict's book itself was a statement of perceived incongruity: the chrysanthemum and the sword.

Benedict's pioneering scholarship may be characterized as belonging to the "shreds and patches" school of anthropology, because shreds and patches of information were all that were available during the earliest period of inquiry into Japanese culture. Unfortunately, the legacy of Benedict's tentative analysis lives long after her work and after "shreds and patches" have been superseded by more-comprehensive data. Karel van Wolferen's *The Enigma of Japanese Power* (van Wolferen, 1989) is another shreds and patches-like interpretation of Japan that emphasizes social, cultural and political incongruity and contradiction in Japan.

This essay argues that interpretations of the Japanese business and economic system are inevitably linked to the frames of reference with which researchers approach Japan. Typically, these frames of reference characterize Japan in one of two oversimplifying ways: either Japan is mysterious, exotic, and full of contradiction (from a Western point of view) or Japan is rather like any other advanced industrial country, even though it is not part of the Western world.

A succession of seven frames of reference, often extreme in how they characterize Japan, has appeared during the past 40 years. From a product life-cycle point of view, therefore, the average Japan paradigm holds sway for about half a decade; five or six years, by the way, is much less time than it takes to research, write, and propagate the studies in the first instance. Post-Benedict, the succeeding frames of reference are largely evolutionary, even

though it may be difficult to find a direct relationship between them. As the number of scholars engaged in research using original materials are few, everybody's work is read by everybody else.

After "shreds and patches", the six succeeding points of view on Japan are

- culture explains everything;
- culture explains nothing (the structure-and-function paradigm);
- culture explains something (the "patterns of behavior" school);
- history explains everything (the "late-development" hypothesis);
- social differences are important even while cultural differences are hard to specify and interpret; and
- culture as learning, hence culture is defined by progressive and most often positive patterns of individual, organizational, and social learning.

MILESTONE STUDIES OF THE JAPANESE FIRM

James Abegglen's *The Japanese Factory* (Abegglen, 1958), published in 1958, represented a substantial step forward in Westerners' knowledge of the Japanese workplace, although it was rooted in a historical interpretation that subsequently has been widely criticized. In his interpretation, Abegglen identified three institutional elements—lifetime employment, seniority-based compensation, and enterprise unionism—that accounted for the distinctiveness of employment and work experience in Japan. Abegglen was not concerned with competitiveness, and so in his work there was no effort to link institutional distinctiveness with industrial competitiveness. Also, Abegglen's explanation for the distinctiveness of Japanese employment relations was incomplete; he did not deal with the substantial differences in employment conditions between large firms and small ones, and he failed to understand how recently the institutional features of modern industrial employment had appeared. Because lifetime employment, seniority-based compensation, and enterprise unionism were so at odds with what was found in the United States, Abegglen mistakenly attributed their existence to deep-rooted, historical patterns in Japan.

Abegglen's explanation for the origins of Japan's employment patterns and practices may have been wrong, however, he was a pioneer in identifying some of the more salient features of the Japanese employment system. Hence, Abegglen's work represented a considerable advance over the "shreds and patches" school of interpretation, and by the 1960s it could be said that American social scientists were looking systematically for predictable patterns of behavior in their assessment of institutional and economic development in various countries around the world. Japan was one of the countries most intensively studied, because, even then, Japan was one of the most remarkable success stories in a genre of academic work generally known as "modernization studies."

Modernization studies were concerned with the process of becoming modern. Modern was defined loosely as a constellation of economic, social, and political features that promoted individualism, representative government, and industrial democracy. While no one was crass enough to suggest that modern meant American, there was a remarkable

convergence in what was held up as "modern" and what was seen as the best of North American and Western European personal, social, and institutional values. Implicitly, what was good for America was good for the rest of the world.

There was an indirect association between modernization studies and the reigning paradigm in sociological studies of work, employment, and industrial development. Talcott Parsons and other leading social scientists had refined a model of behavioral and social activity that was usually labeled the "structural-functional" school. This was the dominant school of analysis in North America although in Europe it had to contend with a number of continental rivals for acceptance. Structural functionalism, defined simply, argued that various structural patterns of activity often masked a remarkable similarity in function.

Robert Cole's book, *Japanese Blue Collar* (Cole, 1971), analyzed the Japanese work place with a structural-functional framework. Unlike Abegglen, Cole found the institutional patterns of employment in Japan to have little to do with culture and history and more with the rationality of developing labor resources in a resource-poor, economically limited society. Lifetime employment makes sense when labor markets are uncertain, skilled labor is in demand, and the efficacy of technology transfer is dependent on the availability of experienced workers. The institutional basis of labor productivity rests more with the stability of employment within individual companies than with union guarantees against layoffs or other acts of managerial coercion common in the West.

A British social scientist stepped in to what had been started by Benedict, Abegglen, and Cole. Ronald Dore took a very different tack. In his *British Factory - Japanese Factory* (Dore, 1973), Dore agreed with Benedict and Abegglen that Japanese industrial organization and relations are different, but he disagreed with Cole that they were the functional equivalents of Western structures and institutions. Dore highlighted the late-development effect—that is, he argued that history makes a difference. When new industrial practices are adopted has a profound effect on how they are adopted.

Dore asserted that the later the onset of industrialization, the more likely government involvement in planning the process of industrialization, the more likely labor-management consensus, the more important the role of ideology in industrialization, and the larger the units of organization in order to cope with the more advanced forms of production and distribution that accompany late industrialization. Thus, Dore posits a late-learning effect to accompany late industrialization. Companies and governments can look around the world, see what others have done, and benefit from their experience. Late industrialization and late learning are what make Japanese industrial relations and employment institutions different. At long last, here was a story that did not assume the non-Western world was simply a pale imitation of a more advanced, Western world. Late development resulted in qualitatively different institutions.

Leading researchers responded to Dore in various ways. Robert Cole stuck to the structure-function model but with some significant modification. Social factors make a difference, sometimes important differences, in the way functional forces are expressed and realized. Consequently, argued Cole's *Work, Mobility, and Participation* and *Strategies for Learning* (Cole, 1979, 1989), the same functional activities, such as the spread of quality control management in modern industrial economies, could be realized in different ways in different social settings. Cole's interpretation in these works emphasizes macro-

organizational forces that significantly influence the way in which functional development is realized.

Another important book in this vein was Chalmers Johnson's *MITI and the Japanese Miracle* (Johnson, 1982). Johnson characterized Japan as a capitalist development state as opposed to America, a capitalist regulatory state. The role of government was to lead, cajole, promote, and develop. Johnson believed that the differences between the role of the state in Japan and that in the West were closely related to Japan's late development and to resulting social and institutional differences in Japan's development trajectory.

In short, institutions matter. For historical, social, and cultural reasons, institutions develop in particular ways with particular consequences. This insight, realized after 40 years of research on Japan, is now culminating in a considerable number of studies where the institutions of business and economics in Japan are taken as central and distinctive, and where they are not seen as the functional equivalents of Western institutions. But, at the same time, the large numbers of Japanese transplant operations in the United States and Canada give the impression that Japanese firms have brought their production and organizational systems to North America.

Martin Kenney and Richard Florida's *Beyond Mass Production* (Kennedy and Florida, 1993) is subtitled "The Japanese System and its Transfer to the U.S." This approach disembodies the development and functioning of the Japanese business system from the system's cultural, social, and institutional context and focuses instead on its "successful" implantation elsewhere in the world. This mode of analysis is frighteningly close to the shreds and patches school of anthropological interpretation initiated by Ruth Benedict some forty years ago. A patchwork of features without social, historical, and cultural grounding becomes the disembodied definition of a robust, successful, elaborate, complex, and fundamentally different economy. The complexity of Japan is encapsulated in an apparently successful transfer of "the Japanese system," an amalgamation of practices that have been "successfully" transferred from Japan.

Finally, the last genre of business studies of Japan, "the culture as learning" point of view, does not have a static picture of what Japanese corporations do or of how they do it. Instead a dynamic, ever changing, ever restless, process of individual, social, and institutional growth and differentiation drives ahead Japanese firms, as it does firms everywhere else in the world. In this view, culture-creation and culture-generation processes occur everywhere. While such processes are universal, they differentiate Japanese behavior from the behavior of all other peoples, because learning is progressive, nearly irreversible, and occurs within specific institutional environments. In this view, while quality-control circles in Japan and the United States may appear to be analogous, in fact they are not. The functioning of quality-control circles in Japan is predicated on what has been found to work there, and quality-control circles in the United States are likewise related to what works here; the workings of quality control circles in the two countries are necessarily different.

As this quick review of milestone studies in Japanese business and management has revealed, Western studies of Japan necessarily reflect a dialectical process: what is studied about Japan is related to what is happening in Western academic circles. What "they" are is related to what "we" are. However, as Japan recovered from the devastation of World War II and as Japanese business has assumed a worldwide importance, the push and pull

of the dialectic changed. "Learning from Japan" is replacing "the study of Japan" as a Western point of view. Japanese business and management issues are mainstream academic fare today. What we are is increasingly linked to what they are. Henceforth, improving knowledge of Japanese technology-management practices is improving knowledge of American technology-management practices.

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Appendix D: Second Round Program Summaries

PROGRAM SUMMARY: UNIVERSITY OF CALIFORNIA, BERKELEY **Japan Management of Technology Program**

(\$1.7 million granted over two years, +\$.3 million cost sharing; Director: Bob Cole)

Prime goal: The program at Berkeley has as its guiding philosophy "the U.S. research and business establishments, while still highly creative, are often unaware of developments—both technical and managerial—originating in Japan." The program is a collaboration among the College of Engineering, the Haas School of Business, and the Department of East Asian Languages. These groups plan to support nearly 20 percent of the cost of the program. The university presently has a certificate in management of technology (MOT) for graduates in business and engineering. Ten to twelve students per year receive the MOT Certificate. Twenty to forty-five take courses in the program. There is already an extensive array of Japanese research and instruction at Berkeley outside the MOT program. For example, "Cross Cultural Management Issues", "Japanese Management and Organization" are two courses taught in the Haas School of Business.

Berkeley is using the AFOSR grant to bolster the existing MOT program with Japanese issues. They are building on the research already established in MOT and building up a language training capability to facilitate this Japanese focus.

School Background: the largest and oldest of nine University of California campuses; 21,590 undergraduate students and 1,586 faculty. The school has offered Japanese language study since 1896. A Center for Japanese Studies was established in 1958. There are presently 2,000 students active in the center and there are 20 faculty members. Berkeley has the largest library collection on Japan in the United States. The Haas School of Business is integrated with the center. There are a few classes on Japanese technology in the M.B.A.-East Asian Studies curriculum.

Program elements: The grant was requested to "expand our interdisciplinary research program in high-technology management that builds on work already underway between faculty at the Haas School of Business and the College of Engineering." Language instruction, fellowships and internships, MOT dissemination, and a television link among national laboratories were to support this primary goal.

Research on High Technology Management in Japanese and U.S. Firms - The research that is funded by the AFOSR grants is distinguished from other Berkeley research by several characteristics. The projects are being carried out collaboratively by faculty and students in the graduate business school and the college of engineering. The topics have been selected with input from local industry, and in several instances with the assistance of industry. The current projects are

- product definition in electronic systems products in the United States and Japan (Professors Bacon, Wilson, Beckman and Mowery; are examining the early phases of the new product development);
- product definition in software products in the United States and Japan (Professors Beckman, Dunn, Malan, and Mowery; will examine international competition in the software industry);
- international computer software industry study (Professor Mowery);
- program design, performance, and technology transfer in research and development (Professors Teese and Mowery);
- management of new process introduction in the semiconductor industry (Professors Leachman, Hodges, and Mowery);
- the role of Japan's national laboratory complex in supporting economic competitiveness (Professors Cole and Mowery);
- team-based work-force organization in the United States, Japanese semiconductor industries (Professor Adiga);
- standardization in manufacturing equipment design in the United States and Japan (Professor Cole); and
- public funding for technology development in Japan (Professor Schaede).

Language Instruction in Technical Japanese - Five hundred students per semester attend modern Japanese language courses at Berkeley. Approximately 100 undergraduate students major in Japanese at Berkeley each year (second in number only to French). For the AFOSR program, a new track in Japanese, emphasizing business and technical applications, was developed. Four new faculty positions were filled to accomplish the MOT emphasis of Japanese language instruction. To facilitate the recruitment of the best candidate available, the director of the Center for Japanese Studies persuaded the Berkeley campus administration to convert the new faculty position in technical Japanese in the East Asian Language Program to a permanent tenured position. The language track is targeted at the MOT program participant but is open to all undergraduate and graduate students as well as outside professionals. It comprises:

- four years of language instruction, with summer intensive options to allow completion in 2 years for masters students in engineering and business administration; and
- business and technical Japanese: a set of three courses offered for the first time in fall 1993.

MOT Fellowships - Five MS candidates from the College of Engineering and four from the School of Business have each received a \$10,000 fellowship, 75 percent of which comes from AFOSR funds, and 25 percent from the school. All will complete studies in the MOT program with the intent of receiving a "certificate."

Professional education program - This is a three-week program that was planned for and directed at the U.S. participants employed in the area.

Instructional TV Link to National Laboratories - This project includes involvement and interaction with Department of Defense and Department of Energy laboratories. A teleconference on technology management is planned for this spring.

Transfer and Dissemination of Research Results

Cooperative efforts with other grantees

**PROGRAM SUMMARY: THE UNIVERSITY OF NEW MEXICO AND THE
UNIVERSITY OF TEXAS AT AUSTIN**

Center for Study of Japanese Industry and Management of Technology

(\$2.7 million granted over two years; Director at University of New Mexico: Wally Lopez)

The University of New Mexico's Center for the Study of Japanese Industry and Management of Technology started with the AFOSR grant in October 1992. The center's director at the University of New Mexico reports directly to the Provost, so the usual wrangling between departments and colleges is reduced. This autonomy is considered a definite strength and is unique among the program schools.

Prime Goal: The idea of the program is "to strengthen U.S. private and military industrial competitiveness through the effective management and implementation of technology among researchers, developers, managers, and users; and to understand the Japanese methods and philosophies of managing technology."

School background:

The University of New Mexico: 28,000 students, 1,200 faculty; 122 years old; largest and most prominent of the state's 22 universities and colleges; key research areas: Optoelectronics, ceramics, noninvasive medical imaging, microelectronics, and mathematics. The Department of Modern and Classical Languages has offered courses in Japanese since 1985. Currently they have a two-year program for Japanese studies. There is an Asian Studies Center that brings together 13 university departments to offer a wide variety of courses relating to Asia. A strength of this program is based on the research work in advanced materials being done in the Albuquerque area, 64 companies like Motorola, Intel,

Sumatomo, etc., and national laboratories like Sandia, Los Alamos, and Phillips Air Force Base. There is also a supercomputer center at Phillips. With this concentration of technical activity, the school can effectively act as a conduit for information on Japanese technology management techniques to the local scientists and engineers.

The University of Texas at Austin: (Director: Fred Phillips); 49,000 students, 2,355 faculty; the Innovation, Creativity, Capital Institute is a major international research center for key business, technological, and economic issues, and is to administer the Japanese Industry and Management of Technology program at Austin. The Japan Business Study Program of the Graduate School of Business is devoted to Japanese language, culture, politics, and current events. The University of Texas at Austin is acting as a subcontractor to the University of New Mexico and will be used for their research expertise.

The International Liaison Office of Microelectronics and Computer Technology Corporation (MCC) is also a subcontractor to the University of New Mexico and will be used to develop the data bases on Japanese language research and development activities. Beginning in May 1993, MCC made the WAIT and NickDat data bases available to all AFOSR grantees. These data bases contain an extensive collection of technical reports and articles published originally in Japanese. Some have been translated into English; some have an English language abstract; others just reference title, subject, and author. These data bases may be the most extensive of their kind in the United States.

Program Elements:

Internships - At the University of New Mexico, an internship training and placement program focuses on training midcareer professionals (23 employees from government laboratories and industry) to understand Japanese industry and practices of managing technology. It now consists of a two-year preparation with one Japanese language and one non-language course each semester. In the two-year period the participant will receive eight semester equivalents of language training. Take note that the participant is also performing a full-time job while taking these courses. There are plans to enroll 35 participants in the fall of 1993. At the end of the two-year preparation, the interns will be placed for one year in an industrial company or research laboratory in Japan. The internship preparation program gives a stipend to cover books, tuition, and time spent during intensive learning sessions; there is no plan to support the student while in Japan. This means that the Japanese host will be asked to contribute, and the stateside employer will be asked to furnish salary. Because of this cost, it is important to get top management buy-in to the program at the start of preparation. The military participants will have trouble here because it will be difficult to arrange a tour of duty that will first allow a participant to go to Japan and then be put to good use when the internship is over and the interns return to the United States. This is a regional program by intent and necessity. On-site and interactive television courses are required of all prospective interns.

Short courses and workshops - A three-day workshop was held 26-28 May 1993 in Austin, titled "Managing Technology the Japanese Way". Other workshops are being planned.

New courses - A nine-day intensive Japanese language course was offered in the summer of 1993. Other courses are being developed.

New academic programs - An M.B.A. with a concentration in MOT is under development; a four-year Japanese language training program is planned to start in fall 1994; a Ph.D. in Intercultural Communication with Emphasis on Japan is proposed by the Communication and Journalism Department and is anticipated to start in the fall of 1994; and an Engineering College/Management School joint degree program in MOT with Japan emphasis is planned to begin in the fall of 1995.

Research program - There are several subjects under consideration. They include emerging Japanese technology areas, and U.S.-Japan technology transfer policy.

Outreach - Efforts included a conference in November 1992, "Opportunities for U.S.-Japan Cooperation," and one in July 1993, "Japanese Intellectual Property Policy." Both were held in Albuquerque.

PROGRAM SUMMARY: THE UNIVERSITY OF PITTSBURGH AND CARNEGIE MELLON UNIVERSITY

The Japanese Science and Technology Management Program

(\$2.7 million was granted over two years; Director: Keith Brown)

Prime goal: The program's goal is to motivate U.S. scientists, engineers, and technical managers to learn the language and the associated culture of Japan, to provide language courses geared to their needs, and to facilitate their training in the shortest amount of time.

School background:

The University of Pittsburgh was established in 1787. There are approximately 20,000 full-time undergraduate students. The Japanese Science and Technology Management Program is administered through the Asian studies program of the University of Pittsburgh. The Asian studies program was established in 1969 and has developed an extensive range of course offerings in Japanese language, history, and culture.

The University of Pittsburgh is a federally designated National Resource Center for East Asian Studies. Nine departments and two professional schools contribute to the center.

Carnegie Mellon University traces its antecedents back to 1900 with the founding of Carnegie Technical School. In 1967, Carnegie Technical School and the Mellon Institute merged to form the present university. It presently is one of the top 20 schools in total

research funding. Carnegie Mellon has a Japan Representative Office in Tokyo and maintains an exchange agreement with Aoyama Gakuin University in Tokyo.

Program elements:

The Japanese Science and Technology Management Program has five major goals:

1. Induce a cadre of scientists and engineers (existing practitioners and students) to pursue in-depth knowledge and sophisticated understanding of Japanese industry and technology management methods for the creative use of science and technology.
2. Provide training in the Japanese language.
3. Provide a knowledge base in Japanese culture, society, and economy.
4. Provide opportunities for participants' thorough immersion in Japanese manufacturing methods for science, industry, and manufacturing through extended internships and study missions.
5. Conduct research on Japanese industry and technology management methods.

Language training - A highly developed Japanese language training program was in place at the University of Pittsburgh, and has been strengthened as a result of the grant. The program includes

- "First (and Second) Year Intensive Japanese" (two ten-credit-hour sessions, each 15 weeks at 25 class hours per week);
- "Technical Japanese," which is designed for the specific needs of scientists and engineers and is aimed to develop broad competencies in reading, speaking, and comprehension (the course, in development at the University of Pittsburgh, is being designed by David Mills); and
- Japanese for Technology and Management I and II (at Carnegie Mellon University), which includes a program of computer aided instruction for written Japanese.

Outreach - A Japanese culture lecture series offered 16 lectures in the evening during the spring of 1993; the series is continuing in the 1993-94 academic year. A Japanese business lecture series of six sessions was offered in spring 1993 and was open to the public. Outside attendance by local industrial managers was high.

Practical experience - The patterns of participation are keyed to the language programs. The University of Pittsburgh has instituted a full-time intensive language program, and gives full support to six or seven graduate students with science and engineering backgrounds. They will, presumably, go to Japan for year-long internships at the end of the language cycle. Carnegie Mellon participants are mainly M.B.A. students with technical undergraduate degrees, who are supported half-time for a half-time intensive language program before going to Japan for a summer internship. Eleven summer internships to Japan were organized

in 1993. Fellowships are granted to finance these trips. One longer-term internship is established, with more planned.

Research - One research project is being funded by the Japanese Science and Technology Management Program: structure and development of the Japanese transplant organizations.

PROGRAM SUMMARY: STANFORD UNIVERSITY
U.S.-Japan Technology Management Center

(\$2.7 million granted over two years; Director: Robert Burmeister)

Prime Goals:

1. Increase the understanding of Japanese industry and technology management methods for the creative use of science and technology, especially in the area of high technology industries.

2. Provide U.S. citizens and permanent resident engineers, scientists, and managers with training in the Japanese language in an efficient manner, and also develop in them an understanding of Japanese business and social culture to increase their effectiveness in decision making in a work economy where the Japanese are major competitors.

3. Provide program participants with opportunities to be directly involved in Japanese scientific research, engineering development, and management activities.

4. Provide mechanisms for the participation of scientists, engineers, and managers from the Department of Defense and Department of Energy laboratories as well as their industrial contractor organizations.

School background: Stanford University is an independent school established in 1885. The current student enrollment is 14,000. The U.S.-Japan Technology Management Center involves the close collaboration of five major groups: the School of Engineering, Graduate School of Business, Asia/Pacific Research Center, Asian Language Department/East Asian Language Program, and the Overseas Studies Program. The Stanford Japan Center was opened in Kyoto in 1989. The center director reports to the Dean of the School of Engineering.

Program elements:

New course development - "Analyzing Japanese High Technology" was attended by 26 on-campus students and was broadcast over the Stanford Instructional Television Network in the fall of 1992. "Japanese Technology R&D Management" is a seminar series that started in the spring of 1993 and was offered to 115 on-campus students and broadcast to 10 off-campus sites. "Introduction to Modern Japanese for Business Persons and Researchers" was piloted in the summer of 1993 as was "Reading Technical Japanese."

Research Program -

- "Advanced Computing in Japan" is an in-depth study of the Real World Computing Project.
- "Computer R&D and Product Development" is a doctoral student's field-based research at a Japanese computer manufacturer's development laboratory in Japan.
- "Flat Panel Display" is developing a computer-based model of the high-volume manufacturing process.
- "Machine Translation" examines the use of optical character recognition and language translation software on scanned documents to determine the viability of practical machine translation from Japanese to English.
- "Optoelectronics" analyses the use of new optoelectronic devices in the Real World Computing Project.
- "Semiconductor Manufacturing" is a symposium on Sensor Based Manufacturing held at the Stanford Japan Center in May 1993.

Practical Experience - Thirty to forty students per year are already placed in internships in Japan as part of the Stanford Japan Center program. The Stanford Center for Technology and Innovation is part of the center. The students spend four or five months in the program with a ten-week preparatory session in Kyoto followed by a two- to three-month summer "internship" in a company or government position in Japan. The AFOSR grant program proposed holding special training sessions to better prepare the interns.

Coordination and Dissemination - Stanford already had close ties with U.S. government laboratories. The U.S.-Japan Technology Management Center is capitalizing on these relationships, especially the one with Lawrence Livermore Laboratory. The establishment of joint ventures is being discussed with industry in the Silicon Valley. For instance, discussions are being held with the Solid States Industrial Affiliates, a group of local businesses that participate in the Stanford Institutional Television Network.

Appendix E: Other Japan-Oriented Organizations in North America

This is a summary of established activities in the United States that have a Japanese focus and contain elements that the Committee to Assess U.S.-Japan Industry and Technology Management Training Programs thinks are important: language, internships, research, dissemination, and coordination. While there always has been considerable interest in the United States about Japan and its people, the last decade has seen an explosion of activity. The majority of this activity captures and disseminates information about Japan in the form of data bases, publications, seminars, and workshops.¹

Dissemination and Coordination: There are over 500 Japan-focused organizations in the United States. Of these, 126 are academic programs or associations. Twenty-one are libraries dedicated to Japanese or East Asian material. Sixteen are reference services with over one hundred on-line data bases containing material dealing with Japan. Forty-four universities plus eleven nonacademic institutions have regular publications concerning Japan. Twenty-nine U.S. universities have campuses in Japan, and fourteen Japanese universities have campuses in the United States.

Research: The National Science Foundation offers seven programs that sponsor research fellows in Japan, and the Japanese government offers five. Fifty-one organizations in the United States, from the Asian Studies Center of the Heritage Foundation to the Smithsonian Institution, encourage exposure to Japanese science and engineering through cooperative research in Japan.

Language: According to the National Foreign Language Center, there are currently over 400 postsecondary Japanese language training programs in the United States. The Modern Languages Association of America² reports that between 1987 and 1990 there was a 97 percent increase in enrollment in such language courses. Further, there are presently 54 universities in the United States that offer graduate courses in Japanese language.

¹ The primary source of the information in this appendix is: Gateway Japan, 1424 16th Street, NW Suite #700, Washington, D.C. 20036, (202) 265-7685.

² The Modern Languages Association of America, 10 Astor Place, 5th Floor, New York, NY, 10003, (212) 475-9500

Internships, Fellowships, and Scholarships: There are 39 exchange programs; 21 universities offer a year abroad in Japan to qualified students.

Other Internship Programs:

- The Department of Commerce U.S.-Japan Manufacturing Technology Fellowship Program
- The National Science Foundation Summer Institute at Tsukuba
- The National Science Foundation-administered Junior Investigator and Post-Doctoral Fellowships
- Short, medium, and long-term visits by senior investigators

Reports:

- Japanese government reports on researcher exchange
- National Foreign Language Center Report on *Japanese Language Instruction in the United States* by Eleanor H. Jordan with Richard D. Lambert.

Non-academic institutions:

- The Asia Society, New York, New York
- The Japan Society, New York, New York